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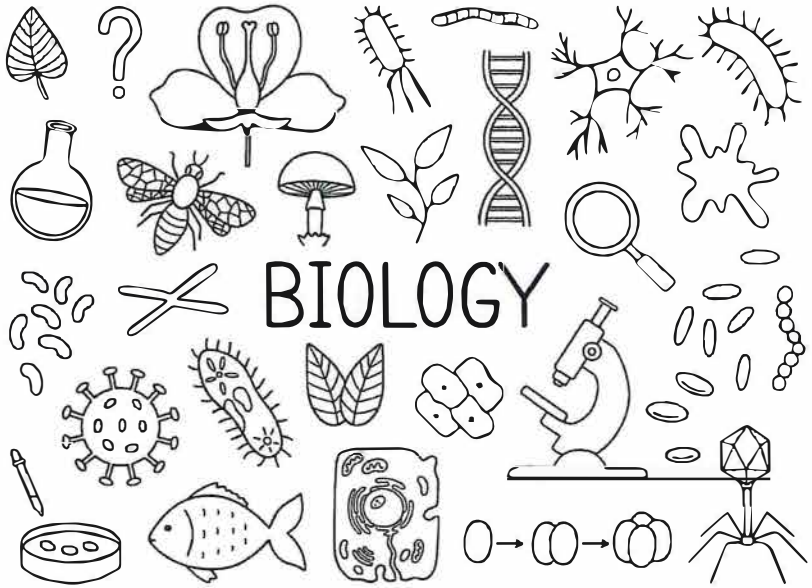
BIOLOGY PAPER 1 REVISION PACK



This booklet contains:

Knowledge organisers

Revision mats and answers

Practice exam paper

Mark Scheme

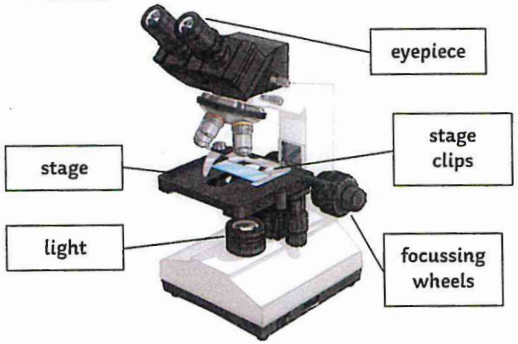
KNOWLEDGE ORGANISERS

Cell Biology Knowledge Organiser – Foundation and Higher

Required Practical

Microscopy Required Practical

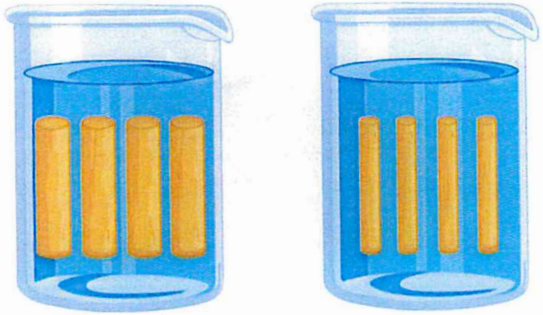
- Includes preparing a slide, using a light microscope, drawing any observations – use a pencil and label important observations.



Osmosis and Potato Practical

- Independent variable – concentration.
- Dependent variable – change in mass.
- Control variable – volume of solution, temperature, time, surface area of the potato.

The potato in the sugar solution will lose water and so will have less mass at the end; the potato in the pure water solution will gain water.



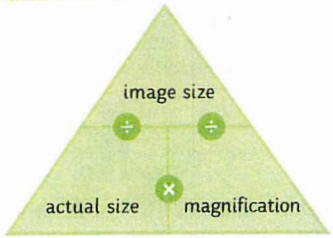
Specialised Cells

When a cell changes to become a specialised cell, it is called differentiation.

Specialised Cell	Function	Adaptation
sperm	To get the male DNA to the female DNA.	Streamlined head, long tail, lots of mitochondria to provide energy.
nerve	To send electrical impulses around the body.	Long to cover more distance. Has branched connections to connect in a network.
muscle	To contract quickly.	Long and contain lots of mitochondria for energy.
root hair	To absorb water from the soil.	A large surface area to absorb more water.
phloem	Transports substances around the plant.	Pores to allow cell sap to flow. Cells are long and joined end-to-end.
xylem	Transports water through the plant.	Hollow in the centre. Tubes are joined end-to-end.

Equations and Maths

Equation



Maths Skills

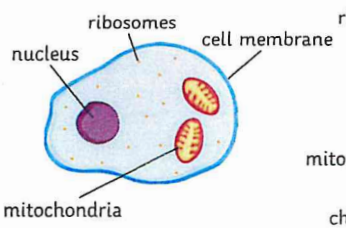
Conversions:
Micrometres to millimetres: divide by 1000.

Standard Form:
$0.003 = 3 \times 10^{-3}$

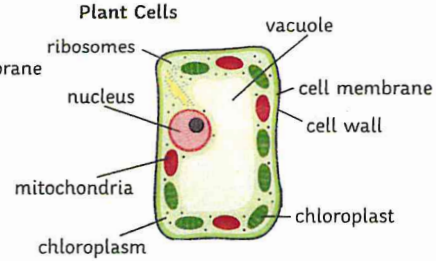
$5.6 \times 10^{-5} = 0.0056$

Prokaryotic and Eukaryotic Cells

Animal Cells



Plant Cells

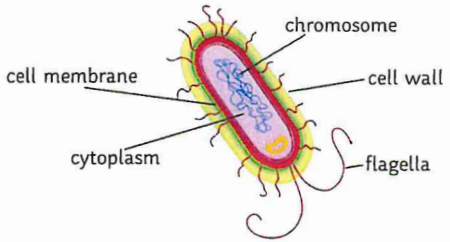


Plant and animal cells have similarities and differences:

	Animal	Plant
nucleus	✓	✓
cytoplasm	✓	✓
chloroplast	X	✓
cell membrane	✓	✓
permanent vacuole	X	✓
mitochondria	✓	✓
ribosomes	✓	✓
cell wall	X	✓

Bacterial Cells

Bacterial cells do not have a true nucleus, they just have a single strand of DNA that floats in the cytoplasm. They contain a plasmid.

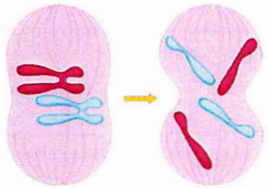


Chromosomes and Mitosis

In the nucleus of a human cell there are 23 pairs of **chromosomes**. Chromosomes contain a double helix of **DNA**. Chromosomes have a large number of genes.

The **cell cycle** makes new cells.

Mitosis: DNA has to be **copied/replicated** before the cell carries out mitosis.



Key Vocabulary

active transport
alveoli
chromosome
diffusion
eukaryotic
gas exchange
mitosis
multicellular
osmosis
prokaryotic
undifferentiated
replicated
specialised
villi

Stem Cells

Embryonic stem cells are **undifferentiated** cells, they have the potential to turn into any kind of cell.

Adult stem cells are found in the bone marrow, they can only turn into some types of cells e.g. blood cells.

Uses of stem cells:

- Replacing faulty blood cells;
- making insulin producing cells;
- making nerve cells.

Some people are against stem cell research.

For Stem Cell Research	Against Stem Cell Research
Curing patients with stem cells - more important than the rights of embryos.	Embryos are human life.
They are just using unwanted embryos from fertility clinics, which would normally be destroyed.	Scientists should find other sources of stem cells.

Stem Cells in Plants

In plants, stem cells are found in the **meristem**. These stem cells are able to produce clones of the plant. They can be used to grow crops with specific features for a farmer, e.g. **disease resistant.**

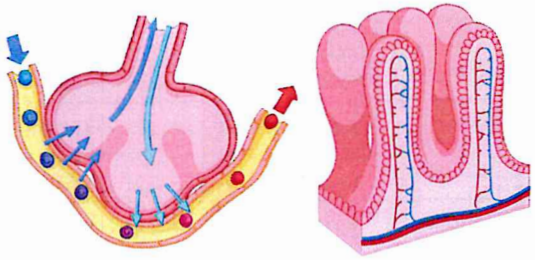
Exchange – Humans

Multicellular organisms have a large surface are to volume ratio so that all the substances can be exchanged.

Gas exchange: Lungs

The alveoli are where gas exchange takes place.

They have a large surface area, moist lining, thin walls and a good blood supply.

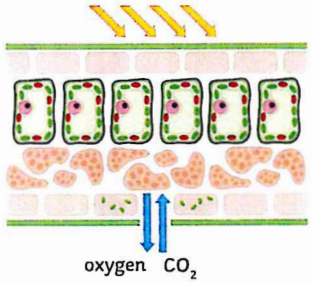


Villi: Small Intestine

Millions of villi line the small intestine increasing the surface area to absorb more digested food.

They are a single layer of cells with a good blood supply.

Exchange in Plants



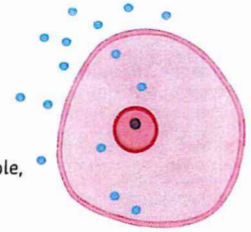
The surface of the leaf is flattened to increase the surface area for more gas exchange by diffusion.

Oxygen and water vapour diffuse out of the stomata. Guard cells open and close the stomata, controlling water loss.

Key Processes

Diffusion is the spreading out of particles from an area of higher concentration to an area of lower concentration.

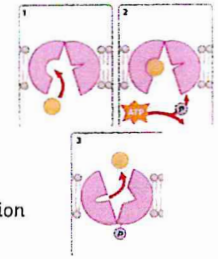
Cell membranes are semi-permeable, only small molecules can get through.



Cell Diffusion

Osmosis is the movement of water molecules across a partially permeable membrane from a region of higher concentration to a region of lower concentration.

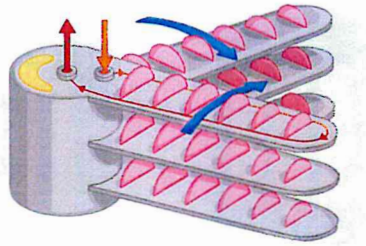
Active transport is the movement of substances against the concentration gradient. This process requires energy from respiration.



Active Transport in Cells

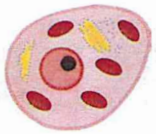
Exchange in Fish

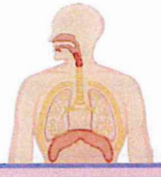
Fish have a large surface area for gas exchange. These are called **gills.** Water enters the fish through the mouth and goes out through the gills. The oxygen is transported from the water to the blood by **diffusion.** Carbon dioxide diffuses from the blood to the water. Each gill has **gill filaments** which give the gills a large surface area. **Lamellae** cover each gill filament to further increase the surface area for more gas exchange. They have a **thin surface layer** and **capillaries** for good blood supply which helps with diffusion.



AQA GCSE Biology (Combined Science) Unit 2: Organisation

Principles of Organisation




cell	→ tissue	→ organ	→ organ system	→ organism
Cells are the basic building blocks of all living things.	A group of cells with a similar structure and function is called a tissue.	An organ is a combination of tissues carrying out a specific function.	Organs work together within an organ system.	Organ systems work together to form whole living organisms.

Food Tests (Required Practical)

What are you testing for?	Which indicator do you use?	What does a positive result look like?
sugar	Benedict's reagent	Once heated, the solution will change from blue-green to yellow-red.
starch	iodine	Blue-black colour indicates starch is present.
protein	biuret	The solution will change from blue to pink-purple.
lipid	sudan III	The lipids will separate and the top layer will turn bright red.

Effect of pH on the Rate of Reaction of Amylase (Required Practical)

Iodine is used to test for the presence of **starch**. If starch is present, the colour will change to blue-black.

The **independent variable** in the investigation is the pH of the buffer solution.

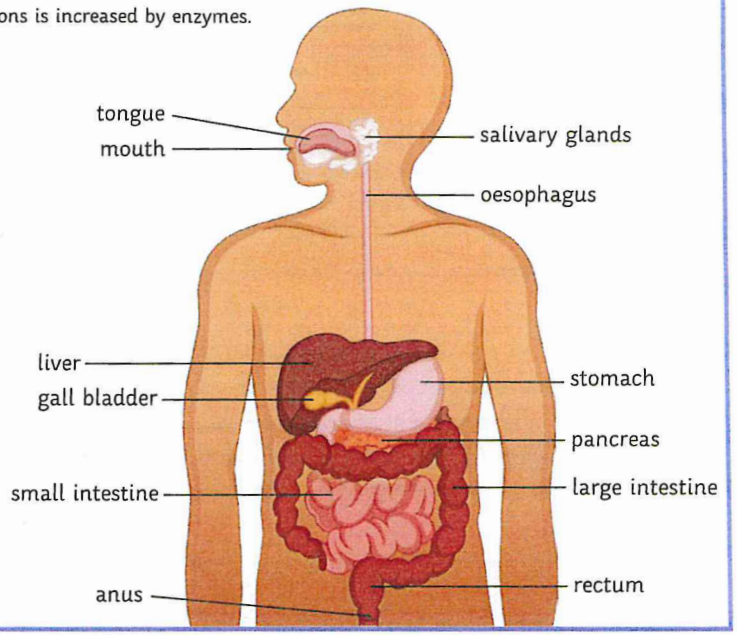
The **dependent variable** in the investigation is the time taken for the reaction to complete (how long it takes for all the starch to be digested by the amylase).

Method:

1. Use the marker pen to label a test tube with the first value of pH buffer solution (pH 4) and stand it in the test tube rack.
2. Into each well of the spotting tiles, place a drop of iodine.
3. Using a measuring cylinder, measure 2cm³ of amylase and pour into the test tube.
4. Using a syringe, measure 1cm³ of the buffer solution and pour into the test tube.
5. Leave this to stand for five minutes and then use the thermometer to measure the temperature. Make a note of the temperature.
6. Add 2cm³ of starch solution into the test tube, using a different measuring cylinder to measure, and begin a timer (leave the timer to run continuously).
7. After 10 seconds, use a pipette to extract some of the amylase/starch solution, and place one drop into the first well of the spotting tile. Squirt the remaining solution back into the test tube.
8. Continue to place one drop into the next well of the spotting tile, every 10 seconds, until the iodine remains orange.
9. Record the time taken for the starch to be completely digested by the amylase by counting the wells that were tested positive for starch (indicated by the blue/black colour change of the iodine). Each well represents 10 seconds of time.
10. Repeat steps 1 to 8 for pH values 7 and 10.

The Digestive System

The purpose of the digestive system is to break down large molecules into smaller, soluble molecules, which are then absorbed into the bloodstream. The rate of these reactions is increased by enzymes.



Enzymes

An enzyme is a biological **catalyst**; enzymes speed up chemical reactions without being changed or used up.

This happens because the enzyme lowers the **activation energy** required for the reaction to occur. Enzymes are made up of chains of amino acids folded into a globular shape.

Enzymes have an **active site** which the **substrate** (reactants) fits into. Enzymes are very specific and will only catalyse one specific reaction. If the reactants are not the complimentary shape, the enzyme will not work for that reaction.

Enzymes also work optimally at specific conditions of pH and temperature. In extremes of pH or temperature, the enzyme will **denature**. This means that the bonds holding together the 3D shape of the active site will break and the active shape will deform. The substrate will not be able to fit into the active site anymore and the enzyme cannot function.

Enzyme	Reactant	Product
amylase	starch	sugars (glucose)
protease	protein	amino acids
lipase	lipid	glycerol and fatty acids

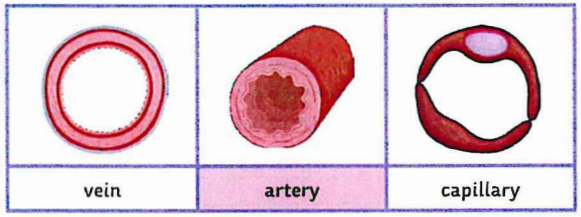
The products of digestion are used to build new carbohydrates and proteins and some of the glucose is used for respiration.

Bile is produced in the **liver** and stored in the gall bladder. It is an **alkaline** substance which **neutralises** the hydrochloric acid in the stomach. It also works to **emulsify** fats into small droplets. The fat droplets have a higher **surface area** and so the rate of their digestion by lipase is increased.

The Heart and Blood Vessels

The **heart** is a large muscular organ which **pumps blood** carrying oxygen or waste products around the body. The **lungs** are the site of **gas exchange** where oxygen from the air is exchanged for waste carbon dioxide in the blood. Oxygen is used in the **respiration** reaction to release energy for the cells and carbon dioxide is made as a waste product during the reaction.

glucose + oxygen ⟶ carbon dioxide + water + [energy]



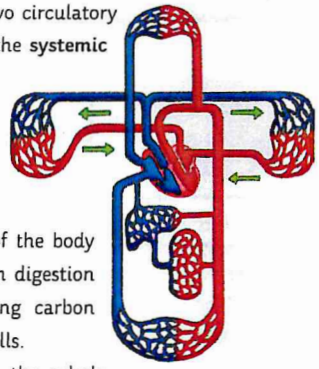
The three types of blood vessels, shown above, are each adapted to carry out their specific function.

Capillaries are narrow vessels which form networks to closely supply cells and organs between the veins and arteries. The walls of the capillaries are only **one cell thick**, which provides a short **diffusion pathway** to increase the rate at which substances are transferred.

The table below compares the structure and function of arteries and veins:

	Artery	Vein
direction of blood flow	away from the heart	towards the heart
oxygenated or deoxygenated blood?	oxygenated (except the pulmonary artery)	deoxygenated (except the pulmonary vein)
pressure	high	low (negative)
wall structure	thick, elastic, muscular, connective tissue for strength	thin, less muscular, less connective tissue
lumen (channel inside the vessel)	narrow	wide (with valves)

The Heart as a Double Pump



The heart works as a **double pump** for two circulatory systems; the **pulmonary** circulation and the **systemic** circulation.

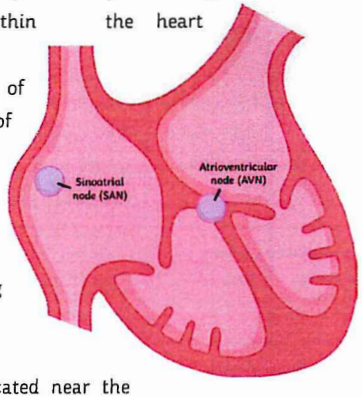
The pulmonary circulation serves the lungs and bring deoxygenated blood to exchange waste carbon dioxide gas for oxygen at the **alveoli**.

The systemic circulation serves the rest of the body and transports oxygen and nutrients from digestion to the cells of the body, whilst carrying carbon dioxide and other waste away from the cells.

The systemic circulation flows through the whole body. This means the blood is flowing at a much higher pressure than in the pulmonary circuit.

The Heart as Pacemaker

The rate of the heart beating is very carefully, and automatically, controlled within the heart itself.

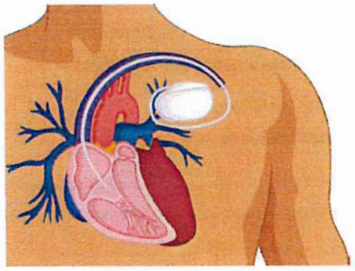


Located in the muscular walls of the heart are small groups of cells which act as pacemakers. They produce electrical impulses which stimulate the surrounding muscle to contract, squeezing the chambers of the heart and pumping the blood.

The **sino-atrial node (SAN)** is located near the right atrium and it stimulates the atria to contract.

The **atrio-ventricular node (AVN)** is located in between the ventricles and stimulates them to contract.

Artificial pacemakers can be surgically implanted into a person if their heart nodes are not functioning correctly.



Coronary Heart Disease

Coronary heart disease is a condition resulting from **blockages** in the **coronary arteries**. These are the main arteries which supply blood to the heart itself and they can become blocked by build-up of **fatty deposits**.

In the UK and around the world, coronary heart disease is a major cause of many **deaths**.

The main symptoms can include **chest pain**, **heart attack** or **heart failure**. Yet, not all people suffer the same symptoms, if any at all.

Lifestyle factors can increase the risk of a person developing coronary heart disease.

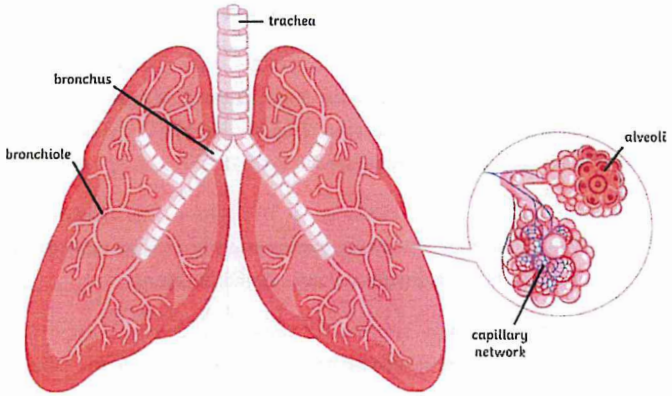
Diet – a high-fat diet (containing lots of saturated fat) can lead to higher cholesterol levels and this cholesterol forms the fatty deposits which damage and block the arteries.

Smoking – chemicals in cigarette smoke, including nicotine and carbon monoxide, increase the risk of heart disease. Carbon monoxide reduces the amount of oxygen which can be transported by the red blood cells and nicotine causes an increased heart rate. The lack of oxygen to the heart and increased pressure can lead to heart attacks.

Stress – prolonged exposure to stress or stressful situations (such as high pressure jobs) can lead to high blood pressure and an increased risk of heart disease.

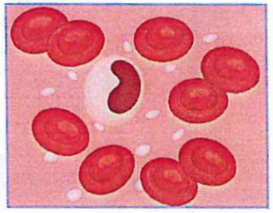
Drugs – illegal drugs (e.g. ecstasy and cannabis) can lead to increased heart rate and blood pressure, increasing the risk of heart disease.

Alcohol – regularly exceeding unit guidelines for alcohol can lead to increased blood pressure and risk of heart disease.



Blood

Blood is composed of red blood cells (erythrocytes), white blood cells and platelets, all suspended within a plasma (a tissue).



The **plasma** transports the different blood cells around the body as well as carbon dioxide, nutrients, urea and hormones. It also distributes the heat throughout the body.

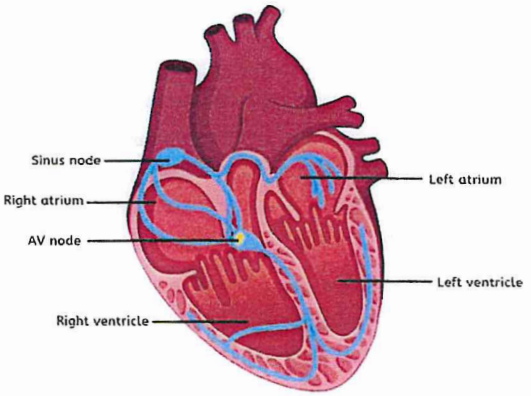
Red blood cells transport oxygen attached to the haem group in their structure. It has a biconcave shape to increase surface area and does not contain a nucleus so it can bind with more oxygen molecules.

White blood cells form part of the immune system and ingest pathogens and produce antibodies. **Platelets** are important blood clotting factors.

at the lungs

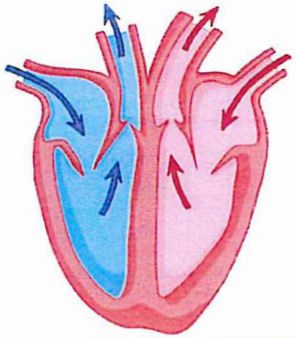
haemoglobin + oxygen $\rightleftharpoons$ oxyhaemoglobin

at the cells



The **right atrium** receives deoxygenated blood via the **vena cava**. It is then pumped down through the valves into the right ventricle. From here, it is forced up through the **pulmonary artery** towards the **lungs** where it exchanges carbon dioxide for oxygen. The oxygenated blood then enters the **left atrium** via the **pulmonary vein** and down into the left ventricle. The muscular wall of the **left ventricle** is much thicker so it can pump the blood more forcefully out of the heart and around the entire body, via the **aorta**.

The blood only flows in **one direction**. This is because there are **valves** in the heart which close under pressure and prevent the backward flow of blood.



Rate Calculations for Blood Flow

The number of beats the heart performs each minute is called the **pulse** (or heart rate).

It is easily measured by counting the number of beats in a given time, e.g. 15s, and finding the total beats **per minute**.

Typically, a lower resting pulse rate indicates a greater level of physical **fitness**. During exercise, and for some time after, the pulse rate increases while the heart is working to provide more **oxygen** to the muscles.

Cardiac output is a measure of the volume of blood pumped by the heart each **minute**. **Stroke volume** is a measure of the volume of blood pumped from the heart each **contraction** (heart beat).

Cardiac output (cm^3/min) = heart rate (bpm) × stroke volume (cm^3/beat)

Cancer

Cancer is the result of **uncontrolled** cell growth and division. The uncontrolled growth of cells is called a **tumour**.

Benign Tumour	Malignant Tumour
• Usually grows slowly. • Usually grows within a membrane and can be easily removed. • Does not normally grow back. • Does not spread around the body. • Can cause damage to organs and be life-threatening.	• cancerous • Usually grows rapidly. • Can spread around the body, via the bloodstream. • Cells can break away and cause secondary tumours to grow in other areas of the body (metastasis).

Plant Tissues, Organs and Systems

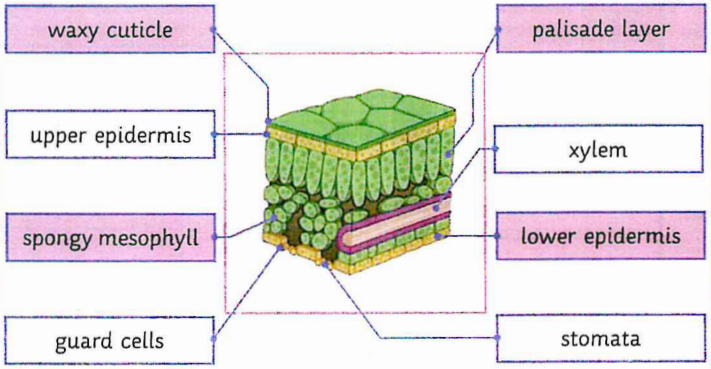
Leaves are plant organs and their main function is to absorb sunlight energy for use in **photosynthesis**. Within the cells are small organelles called **chloroplasts** which contain a green pigment called **chlorophyll**. This is the part of the plant which absorbs the sunlight and where photosynthesis occurs.

$$\text{carbon dioxide + water} \xrightarrow{\text{sunlight}} \text{oxygen + glucose}$$

Leaves are adapted to carry out their function. Leaves are typically flat and thin with a large **surface area**. This means they have a maximum area to absorb the sunlight and carbon dioxide. The **thin** shape reduces the distance for **diffusion** of water and gases.

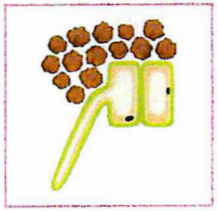
Leaves contain vessels called xylem and phloem. The **xylem** transport water and dissolved minerals toward the leaves. The **phloem** transport glucose and other products from photosynthesis around the plant.

The large **air spaces** between the cells of the spongy mesophyll layer allow for the diffusion of gases. **Carbon dioxide** enters the leaves and **oxygen** exits the leaves.



The **guard cells** are specially adapted cells located on the underside of the leaf. They are positioned in pairs, surrounding the **stomata** (a small opening in the epidermis layer). The guard cells change shape to open and close the stomata, controlling the rate of **gas exchange** in the leaf.

Root Hair Cells

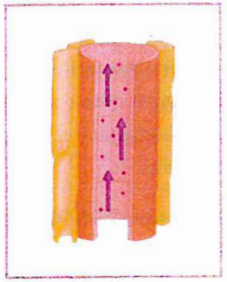


Plants absorb water by **osmosis** through the root hair cells of the roots. Dissolved in the water are important minerals for the plant's growth and development, which are absorbed by **active transport**.

The **root hair cells** are adapted to their function with the following features:

- Finger-like projection in the membrane increases the **surface area** available for water and minerals to be absorbed across.
- The narrow shape of the projection can squeeze into small spaces between soil particles, bringing it closer and reducing the distance of the **diffusion pathway**.
- The cell has many **mitochondria**, which release energy required for the active transport of some substances.

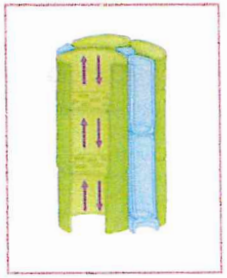
Xylem and Phloem



Xylem vessels transport **water** through the plant, from roots to leaves. They are made up of **dead**, lignified cells, which are joined end to end with no walls between them, forming a long central tube down the middle. The movement of the water, and dissolved minerals, along the xylem is in a **transpiration** stream.

Xylem vessels also provide **support** and **strength** to the plant structure. They are found in the middle of roots so they aren't crushed within the soil. They are found in the middle of the stem to provide strength and prevent bending. In the leaves, they are found in **vascular bundles** alongside the phloem and can be seen as the veins which network across the leaf.

Phloem vessels transport **food** such as dissolved sugars and glucose from photosynthesis. The food is transported around the plant to where growth is occurring (root and shoot tips), as well as to the organs which store the food. The transport occurs in **all directions** throughout the plant. The cells making up the phloem tube are **living**, with small holes in the walls where the cells are joined.



Transpiration and Translocation

Transpiration is the loss of water, by **evaporation** and **diffusion**, from the leaves of the plant. Water is a cohesive molecule and as it evaporates, there is less water in the leaf, so water from further back moves up to take its place. This, in turn, draws more water with it. This is the **transpiration stream**.

Transpiration occurs naturally as there is a tendency for water to diffuse from the leaves (where the concentration is relatively high) to the air around the plants (where the concentration is relatively low), via the **stomata**.

Environmental factors can change the rate at which transpiration occurs:

- Increased **light intensity** will increase the rate of transpiration because light stimulates the stomata to open. The leaf will also be warmed by the sunlight.
- Increased **temperature** will cause the water to evaporate more quickly and so increase the rate of transpiration.
- Increased **humidity** (moisture in the air) will reduce the rate of transpiration. Whereas if the air becomes drier, the rate increases. A greater concentration gradient will increase the rate of diffusion.
- If the **wind speed** increases, then the rate of transpiration also increases. This is because as the water surrounding the leaves is moved away more quickly, the concentration gradient is increased.
- If the **water content** in the soil is decreased, then the rate of absorption in the roots decreases. This causes the stomata to become flaccid and close, reducing transpiration. If the loss of turgor affects the whole plant, then it will wilt.

Disease Interactions

Having one type of illness can often make a person more susceptible to another type of illness:

- immune disorders → increased risk of infectious disease
- viral infection of cells → increased risk of cancer
- immune reactions → can trigger allergies
- very poor physical health → increased risk of depression or other mental illness

Health and Disease

Health is the state of being free from **illness** or **disease**. It refers to **physical** and **mental** wellbeing.

Disease and lifestyle factors, such as diet, stress, smoking, alcohol consumption and the use of illegal drugs, can all impact the health of a person.

Some conditions are associated with certain lifestyle choices:

- Liver conditions are associated with poor **diet** and prolonged excessive **alcohol** consumption.
- Lung cancer is associated with **smoking**.
- Memory loss, poor physical health and hygiene are associated with the use of illegal or recreational **drugs**.
- Obesity and diabetes are associated with poor diet.
- Anxiety and depression are associated with **stress** and prolonged excessive alcohol consumption.

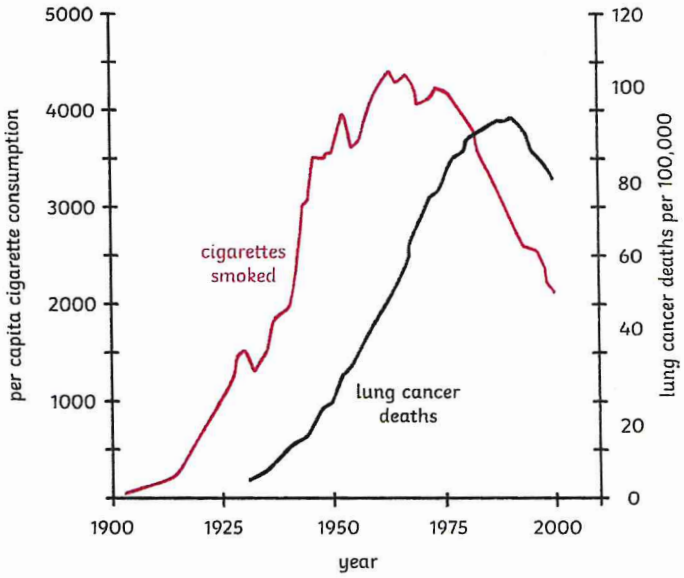
There can often be correlations between some factors and types of illness or specific diseases.

For example, in the graph shown to the right, there is a positive correlation between the number of cigarettes smoked and the number of lung cancer deaths.

However, there are other factors which can contribute to the development of lung cancer e.g. working with asbestos, genetic predisposition.

This means that although the evidence in the graph gives a strong indication that smoking is a cause of lung cancer, it cannot be stated that **'smoking will cause lung cancer'**. Not every person who smokes will develop lung cancer and not every person who develops lung cancer will be a smoker.

Therefore, it can be stated that **smoking increases the risk of lung cancer**.



Heart Disease (Treatments)

There are a range of medical treatments for heart disease.

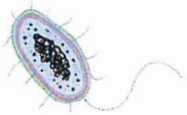
Treatment	Description	Advantages	Disadvantages
statins	**Drugs** used to lower cholesterol levels in the blood, by reducing the amount produced in the liver.	• Can be used to prevent heart disease developing. • Improved quality of life.	• Long-term treatment. • Possible negative side-effects.
stents	**Mechanical device** which is used to stretch narrow or blocked arteries, restoring blood flow.	• Used for patients where drugs are less effective. • Offers long-term benefits. • Made from metal alloys so will not be rejected by the patients body. • Improved quality of life.	• Requires surgery under general anaesthetic, which carries risk of infection.
heart transplant	The entire organ is replaced with one from an organ **donor** (a person who has died and previously expressed a wish for their organs to be used in this way).	• Can treat complete heart failure in a person. • extended life • Improved quality of life. • Artificial plastic hearts can be used temporarily until a donor is found.	• Requires major surgery under general anaesthetic, which carries risks. • Lack of donors available. • Risk of infection or transplant rejection. • Long recovery times.

Infection and Response Knowledge Organiser – Foundation and Higher

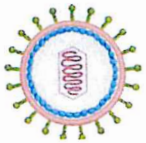
Communicable Disease

Pathogens are **microorganisms** that enter the body and cause communicable disease (infectious). Plants and animals can be infected by them.

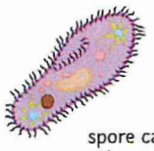
Bacteria are small cells that can reproduce very quickly in the body. They produce **toxins** that make you feel ill, damaging your cells and tissues.



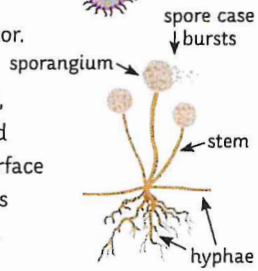
Viruses are much smaller than bacteria; they can also reproduce quickly in the body. Viruses live inside your cell where they replicate. They then burst out of the cell, releasing new viruses.



Protists are eukaryotes (multicellular). Some are parasites which live on or inside other organisms, often carried by a vector.



Fungi are sometimes single celled, others have hyphae that grow and penetrate human skin and the surface of plants. They can produce spores which can spread to other plants.



How Pathogens Are Spread

Pathogens can be spread in many ways, for example:

Water – by drinking dirty water, e.g. cholera.

Air – carried by air and breathed in, e.g. influenza.

Direct contact – touching contaminated surfaces including the skin, e.g. athlete's foot.

Viral Diseases

Measles is spread by droplets of liquid from sneezes and coughs etc., symptoms include a red rash on the skin and a fever. Measles can be serious or even fatal, it can lead to pneumonia. Most people are vaccinated against measles when they are very young.

HIV is spread by sexual contact or exchanging body fluids. HIV can be controlled be antiviral drugs; this stops the viruses replicating. The virus attacks the cells in the immune system. If the immune system is badly damaged, the body cannot cope with other infections. This is the late stage and is called aids.

Tobacco mosaic virus affects plants, parts of the leaves become discoloured. This means plants cannot carry out photosynthesis; this will affect the plants growth.

Fungal and Protist Diseases

Fungal

Rose black spot shows as black spots on the leaves of the plant, this means less photosynthesis occurs. As a result, the plant does not grow as well. It is spread by the wind or the water. They can be treated by using fungicides and taking the leaves off the infected plant.

Protists

Malaria is caused by a protist, mosquitoes are the vectors. They become infected when they feed on an infected animal. The protist is inserted into the blood vessel. Malaria can cause fever, it can also be fatal.

Bacterial Diseases

Salmonella bacteria causes food poisoning. Symptoms include fever, stomach cramps, vomiting and diarrhoea. The symptoms are caused by the toxins produced by the bacteria. Food contaminated with salmonella can give you food poisoning. Most poultry in the UK will have had a vaccination against salmonella.

Gonorrhoea is a sexually transmitted bacterial disease, passed on by sexual contact. Symptoms include pain when urinating and thick yellow/green discharge from the vagina or penis. To prevent the spread, people should be treated with antibiotics and use a condom.

How to prevent the spread:

Being hygienic –

washing hands thoroughly.

Destroying vectors –

killing vectors by using insecticides or destroying their habitat.

Isolation –

isolating an infected person will prevent the spread.

Vaccination –

people cannot develop the infection and then pass it on.

Infection and Response Knowledge Organiser – Foundation and Higher

Fighting Diseases

Defence System

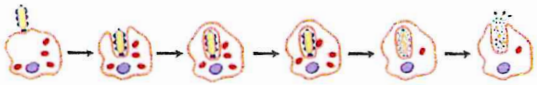
1. The skin acts as a barrier to pathogens.
2. Hairs and mucus in your nose trap particles.
3. The trachea and bronchi secrete mucus to trap pathogens. They also have cilia which move backwards and forwards to transport the mucus towards the throat. This traps any pathogens and the mucus is usually swallowed.
4. The stomach contains hydrochloric acid to kill any pathogens that enter the body via the mouth.

The Immune System

This kills any pathogens that enter the body.

White blood cells:

- **Phagocytosis** is when white blood cells engulf pathogens and then digest them.
- They produce **antitoxins** to neutralise the **toxins**.
- They also produce **antibodies**. Pathogens have **antigens** on their surface, antibodies produced by the white blood cells lock on to the antigen on the outside of the pathogen. White blood cells can then destroy the pathogens. Antibodies are specific to one antigen and will only work on that pathogen.



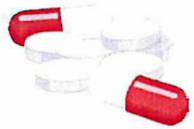
Vaccinations

Vaccinations have been developed to protect us from future infections. A vaccination involves an injection of a **dead** or **weakened** version of the pathogen. They carry antigens which cause your body to produce antibodies which will attack the pathogen. If you are infected again, the white blood cells can produce antibodies quickly.

Pros	Cons
Helps to control communicable diseases that used to be very common.	They don't always work.
Epidemics can be prevented.	Some people can have a bad reaction to a vaccine – however, that is very rare.

Fighting Disease – Drugs

Painkillers relive the pain and symptoms, but do not tackle the cause.



Antibiotics kill the bacteria causing the problem, but do not work on viruses. Viruses are very difficult to kill because they live inside the body cells.

Developing Drugs

There are three main stages in drug testing:

Pre-clinical testing:

1. Drugs are tested on human cells and tissues.
2. Testing carried out on living animals.

Clinical testing:

3. Tested on healthy human volunteers in clinical trials. Starts with a very low dose, then tested on people with the illness to find the optimum dose.

Placebo is a substance that is like the drug, but does not do anything.

Placebo effect is when the patient thinks the treatment will work even though their treatment isn't doing anything.

Blind trial is when the patient does not know whether they are getting the drug or the placebo.

Double-blind trial is when both the doctor and the patient do not know whether they are getting the drug.

Drugs from Plants

Chemicals produced by plants to defend themselves can be used to treat human diseases or help with symptoms.

Drug	Plant/Microorganism
aspirin	willow
digitalis	foxglove
penicillin	mould - penicillium

New drugs are now made by chemists, who work for the pharmaceutical industry, in laboratories.

Key Vocabulary

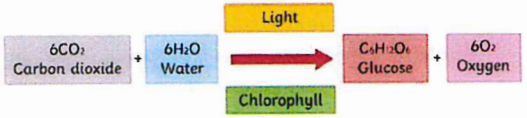
antibodies
antigens
antitoxins
bacteria
blind trial
double-blind
fungus
microorganism
phagocytosis
placebo
protist
toxins
vaccination
vector
virus

AQA GCSE (Combined Science) Unit 4: Bioenergetics Higher

Photosynthesis

Photosynthesis is a chemical reaction which takes place in plants. It converts **carbon dioxide** and **water** into **glucose** and **oxygen**. It uses **light** energy to power the chemical reaction, which is absorbed by the green pigment **chlorophyll**. This means that photosynthesis is an example of an **endothermic** reaction. The whole reaction takes place inside the **chloroplasts** which are small organelles found in plant cells.

Plants acquire the carbon dioxide via diffusion through the **stomata** of their leaves. The water is absorbed from the soil through the **roots** and transported to the cells carrying out photosynthesis, via the **xylem**.



The glucose made in photosynthesis is used for respiration, stored as starch, fat or oils, used to produce cellulose or used to produce amino acids for protein synthesis.

The Rate of Photosynthesis and Limiting Factors

A **limiting factor** is something which stops the photosynthesis reaction from occurring at a faster rate. **Temperature**, **light intensity** and **carbon dioxide** level are all limiting factors.

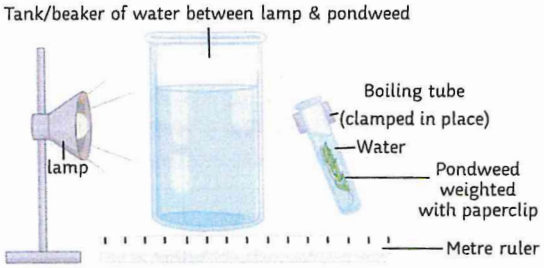
Increasing the temperature of the surroundings will increase the rate of reaction, but only up to around 45°C. At around this temperature, the enzymes which catalyse the reaction become denatured.

Increasing the light intensity will increase the rate of reaction because there is more energy to carry out more reactions.

Increasing the carbon dioxide concentration will also increase the rate of reaction because there are more reactants available.

The Effect of Light Intensity on the Rate of Photosynthesis (RPI)

The amount of light a plant receives affects the rate of photosynthesis. If a plant receives lots of light, lots of photosynthesis will occur. If there is very little or no light, photosynthesis will stop.



Method

1. Measure 20cm^3 of sodium hydrogen carbonate solution and pour into a boiling tube.
2. Collect a 10cm piece of pondweed and gently attach a paper clip to one end.
3. Clamp the boiling tube, ensuring you will be able to shine light onto the pondweed.
4. Place a metre rule next to the clamp stand.
5. Place the lamp 10cm away from the pondweed.
6. Wait two minutes, until the pondweed has started to produce bubbles.
7. Using the stopwatch, count the number of bubbles produced in a minute.
8. Repeat stages 5 to 7, moving the lamp 10cm further away from the pondweed each time until you have five different distances.
9. Now repeat the experiment twice more to ensure you have three readings for each distance.

The **independent** variable was the light intensity.

The **dependent** variable was the amount of bubbles produced. Counting the bubbles is a common method, but you could use a gas syringe instead to more accurately measure the volume of oxygen produced.

The **control** variables were same amount of time and same amount of pondweed. A bench lamp is used to control the light intensity and the water in the test tube containing the pondweed is monitored with a thermometer to monitor and control the temperature.

Interaction of Limiting Factors (HT only)

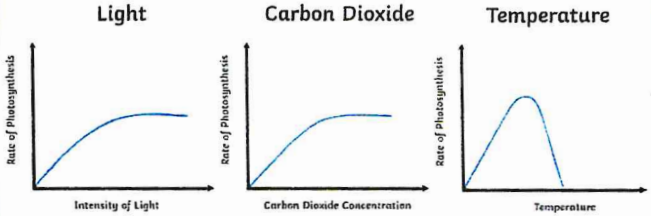
The limiting factor for the reaction will depend on the environmental conditions.

For example:

At night, light intensity is the limiting factor.

In winter, temperature is the limiting factor.

In other conditions, carbon dioxide is usually the limiting factor.



From the graph, you can see that increasing one of the factors will also increase the rate of reaction, but only for so long before it plateaus. This is because another factor will have then become the limiting factor. E.g. you could increase the supply of carbon dioxide, but if there is not enough chlorophyll to absorb the sunlight, then the sunlight will become the limiting factor instead.

Greenhouse Economics (HT only)

To grow plants in the most suitable conditions, a greenhouse can be used.

A greenhouse traps the sun's radiation as heat inside the greenhouse, so that temperature is not a limiting factor for the rate of photosynthesis.

Artificial lighting can be installed in the greenhouse to provide constant light energy and prevent light intensity being a limiting factor.

A paraffin heater can be used in the greenhouse to not only maintain a suitable temperature, but the by-product of the combustion off the paraffin is carbon dioxide.

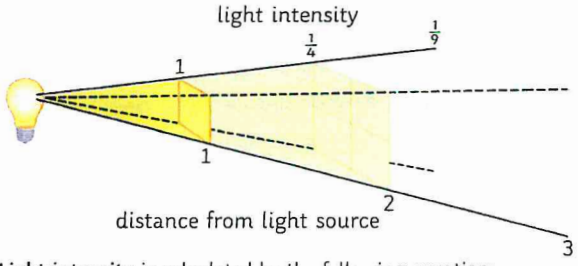
Enclosing the crops in a greenhouse and regulating all the conditions in this way can be expensive; however, it is often outweighed because the harvest of the crop is much healthier, faster-grown crops. Furthermore, the enclosed conditions mean that disease and pests can be easily controlled and prevented.

AQA GCSE (Combined Science) Unit 4: Bioenergetics Higher

Inverse Square Law and Light Intensity

The **inverse square law** is used to describe the light intensity at different distances from the source.

The inverse square law states that: **the intensity of light is inversely proportional to the square distance from the source.**



Light intensity is calculated by the following equation:

$$\text{light intensity} \propto \frac{1}{\text{distance}^2}$$

- The symbol, ∝, means 'is proportional to'.
- Distance is measured in metres, m.

In other words, if an object is moved twice as far away from the light source, the light intensity received is reduced to just one quarter.

Worked example:

If the light source is 10cm from a plant, calculate the light intensity reaching the plant.

$1 \div (\text{distance}^2)$

$1 \div (0.10 \times 0.10)$

$1 \div 0.01$

= 100 arbitrary units

If the light source is moved 25cm from the plant, calculate the light intensity reaching the plant.

$1 \div (\text{distance}^2)$

$1 \div (0.25 \times 0.25)$

$1 \div 0.0625$

= 16 arbitrary units

Respiration

Respiration is the chemical reaction which occurs inside the **mitochondria** of all living cells to release energy for living functions and processes, e.g. movement, warmth and building larger molecules for growth and repair. The reaction is **exothermic**, meaning that energy is released to the surroundings.

Respiration can be either **aerobic** (using oxygen) or **anaerobic** (without using oxygen).

glucose + oxygen → carbon dioxide + water + energy

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + ATP$

In anaerobic respiration, the glucose is not completely oxidised. This means that there is less energy released than in aerobic respiration.

glucose → lactic acid + energy

$C_6H_{12}O_6 \rightarrow 2C_3H_6O_3 + ATP$

In plants and yeast, anaerobic respiration makes some different products. The reaction is also called fermentation and is used in bread-making and beer-brewing.

glucose → ethanol + carbon dioxide + energy

$C_6H_{12}O_6 \rightarrow C_2H_5OH + CO_2 + ATP$

Effect of Exercise

When a person exercises, their body (specifically their **muscles**) need much more energy. To release more energy, the amount of respiration reactions occurring has to increase.

The **heart** pumps faster and the **breathing** rate and breath volume all increase to supply more **oxygen** to the muscles via the bloodstream.

If the muscles are not receiving enough oxygen to keep up the demand needed by the respiration reactions, then **anaerobic** respiration begins to occur. This incomplete oxidation of the glucose produces **lactic acid**, which can build up in the muscles and results in an **oxygen debt**.

After long periods of exercise, the muscles can become fatigued and stop contracting. You might experience a pain commonly called a **stitch**.

Metabolism

Metabolism is the combination of all the reactions in a cell or in the body.

Energy released during respiration is used during metabolic processes to synthesise new molecules:

- Glucose is converted to starch, glycogen and cellulose.
- Glycerol and three fatty acids are joined to form a lipid molecule.
- Glucose and nitrate ions are joined to form amino acids.
- Amino acids are joined to form proteins.
- Excess proteins are broken down and released as urea during excretion.

Respiration itself is also a process which is included in metabolism.

Oxygen Debt (HT only)

During vigorous exercise, the body can begin to carry out **anaerobic respiration** and produces **lactic acid**.

Lactic acid is transported via the bloodstream to the **liver**. The liver converts the lactic acid back into **glucose**. However, **oxygen** is needed to carry out this reaction.

The **oxygen debt** is the amount of the oxygen required by the body to convert the built-up lactic acid back into glucose and remove it from the respiring cells.

REVISION MATS

a

Draw and label a typical plant cell.

Which organelle is...

- the site of aerobic respiration?

_____

- the site of protein synthesis?

_____

- the site of photosynthesis?

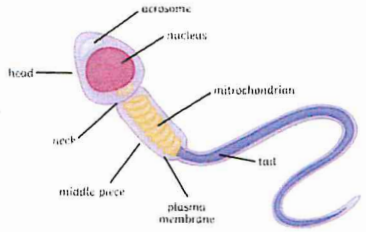
_____

b

Sperm cells are specialised cells. Explain how the acrosome helps the sperm cell to carry out its function.

_____

_____



c

Draw and label the parts of a typical bacterial cell.

d

Why do cells undergo mitosis?

_____

What has to happen before the cell divides?

_____

_____

What happens to the cell during mitosis?

1. _____

_____

2. _____

_____

3. _____

e

What are 'embryonic' stem cells?

_____

Name two medical conditions that could be treated with embryonic stem cells in the future.

1. _____
2. _____

f

Diffusion is: (Tick the correct box.)

a. The movement of water particles from a high water concentration to a lower water concentration across a partially permeable membrane. ☐

b. The spreading out of the particles of any gas or liquid from an area of high concentration to an area of lower concentration. ☐

c. The movement of particles from a low concentration to a higher concentration. ☐

g

Light microscopes have objective lenses.

What is the purpose of the objective lens?

_____

h

What is osmosis?

_____

_____

_____

i

Name three substances that are transported into, or out of, animal cells by diffusion.

1. _____
2. _____
3. _____

j

Name the tubes that transport the food around the plant.

_____

k

How many chromosomes does...

- a human skin cell contain?

_____

- a human gamete contain?

_____

l

Name the tubes that transport water up the stem of a plant.

_____

m

Draw and label a typical animal cell.

Which organelle is...

- the site of aerobic respiration?

_____

- controls the movement of substances in and out of the cell?

_____

- contains the genetic information?

_____

n

Root hair cells are specialised cells. Describe how the root hair cell is adapted to carry out its function.

o

How do prokaryotic cells differ from eukaryotic cells?

p

Plants can be cloned from meristem cells. Give two advantages of cloning plants.

1.

2.

q

Describe two ways in which active transport is different to diffusion.

1.

2.

r

Describe how active transport is used by the following:

1. plants
2. animals

s

Where in the body are adult stem cells found and how do they differ from embryonic stem cells?

t

Write each of the following numbers in standard form.

2500

0.003

4 200 000

0.00000006

u

The unit centimetres is written as cm. What do each of the following units represent?

mm:

µm:

nm:

pm:

v

What is the equation for calculating the magnification of an image?

w

Describe three ways that exchange surfaces are adapted to their function.

1.

2.

3.

x

Why do some people object to embryonic stem cell research?

y

Which has a bigger surface area to volume ratio, an elephant or a mouse?

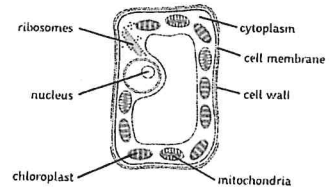
z

The width of a cell is 0.025mm; under the microscope it is 10mm.

What was the magnification?

a

Draw and label a typical plant cell.



Which organelle is...

- **the site of aerobic respiration?**

  mitochondria

- **the site of protein synthesis?**

  ribosomes

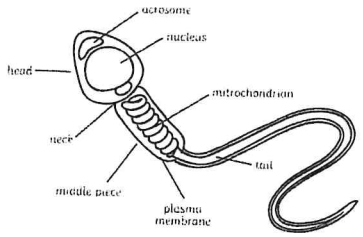
- **the site of photosynthesis?**

  chloroplasts

b

Sperm cells are specialised cells. Explain how the acrosome helps the sperm cell to carry out its function.

The acrosome contains enzymes that digest through the egg cell membrane.



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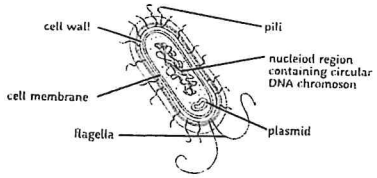
Draw and label the parts of a typical bacterial cell.



d

Why do cells undergo mitosis?

To produce new cells for growth and repair.

What has to happen before the cell divides?

The cell grows and increases the amount of organelles, and it replicates its DNA.

What happens to the cell during mitosis?

1. Chromosomes line up in the centre of the cell and copies are pulled apart by spindle fibres to opposite ends of the cell.
2. Nuclear membranes form around the chromosomes to make two nuclei.
3. Finally, the cell splits into two identical 'daughter' cells.

e

What are 'embryonic' stem cells?

Undifferentiated cells found in the early embryo.

Name two medical conditions that could be treated with embryonic stem cells in the future.

1. diabetes
2. spinal injuries/paralysis

f

Diffusion is: (Tick the correct box.)

a. **The movement of water particles from a high water concentration to a lower water concentration across a partially permeable membrane.** ☐

b. **The spreading out of the particles of any gas or liquid from an area of high concentration to an area of lower concentration.** ☑

c. **The movement of particles from a low concentration to a higher concentration.** ☐

g

Light microscopes have objective lenses.

What is the purpose of the objective lens?

To form and magnify an image of the specimen.

h

What is osmosis?

The movement of water molecules from an area of high water concentration to an area of lower water concentration across a partially permeable membrane.

i

Name three substances that are transported into, or out of, animal cells by diffusion.

1. oxygen
2. carbon dioxide
3. amino acids

j

Name the tubes that transport the food around the plant.

phloem

k

How many chromosomes does...

- **a human skin cell contain?**

  46/23 pairs (diploid)

- **a human gamete contain?**

  23 single (haploid)

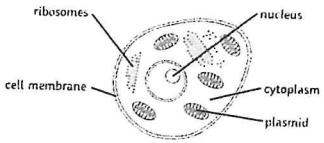
l

Name the tubes that transport water up the stem of a plant.

xylem

m

Draw and label a typical animal cell.



Which organelle is...

- **the site of aerobic respiration?**

  mitochondria

- **controls the movement of substances in and out of the cell?**

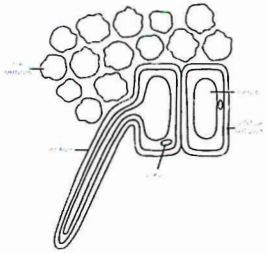
  cell membrane

- **contains the genetic information?**

  nucleus

n **Root hair cells are specialised cells. Describe how the root hair cell is adapted to carry out its function.**

It has a large surface area for the rapid absorption of water and mineral ions from the soil.



o **How do prokaryotic cells differ from eukaryotic cells?**

Bacterial cells are much smaller. They don't have a nucleus, mitochondria or chloroplasts. They do have plasmids with extra DNA.

p **Plants can be cloned from meristem cells. Give two advantages of cloning plants.**

1. Farmers can produce clones of a desired plant quickly and cheaply.
2. Saves rare species from extinction.

q **Describe two ways in which active transport is different to diffusion.**

1. Moves against a concentration gradient (low to high).
2. requires energy

r **Describe how active transport is used by the following:**

1. **plants**
   To obtain mineral ions from the soil.
2. **animals**
   To absorb nutrients (e.g. glucose) from the small intestine when they are at low concentrations.

s **Where in the body are adult stem cells found and how do they differ from embryonic stem cells?**

Found in the bone marrow.

They can only turn into certain cell types, such as blood cells.

t **Write each of the following numbers in standard form.**

2500 2.5×10^3

0.003 3×10^{-3}

4 200 000 4.2×10^6

0.00000006 6×10^{-8}

u **The unit centimetres is written as cm. What do each of the following units represent?**

mm: millimetres

µm: micrometres

nm: nanometres

pm: picometres

v **What is the equation for calculating the magnification of an image?**

$$\text{magnification} = \frac{\text{image size}}{\text{real size}}$$

w **Describe three ways that exchange surfaces are adapted to their function.**

1. large surface area
2. thin walls
3. moist/good blood supply (animals)

x **Why do some people object to embryonic stem cell research?**

They believe that all embryos have the potential to become a human being, so should not be used for experimentation.

y **Which has a bigger surface area to volume ratio, an elephant or a mouse?**

mouse

z **The width of a cell is 0.025mm; under the microscope it is 10mm**

What was the magnification?

magnification = 10 ÷ 0.025 = 400

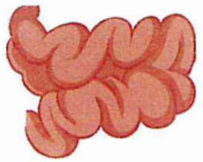
a

Place the following structures in order from smallest to largest:

cell | organ | nucleus | tissue | organism

1. _____
2. _____
3. _____
4. _____
5. _____

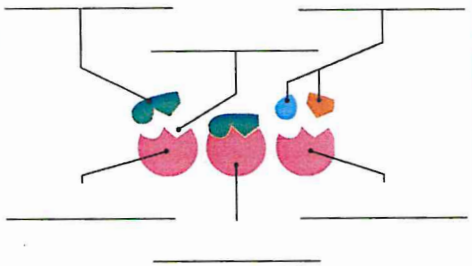
b



The _____ is the part of the body where food is absorbed into the bloodstream.

c

The diagram below shows the **lock and key** model of enzyme function. Label the diagram using the following words:
enzyme, active site, substrate, products, enzyme-substrate complex.



d

Define what an enzyme is.

_____

e

Enzymes are described as being **specific** to a substrate. What does this mean? Use the diagram to help your explanation.

_____

_____

_____

f

Bile is made in the liver and stored in the gall bladder.

Bile neutralises s _____ a _____ to lower the pH so protease enzymes can work.

It also e _____ fats to give them a larger s _____ a _____ for lipase to work on. This speeds up d _____.

g

Describe how to carry out the test for reducing sugars.
Keywords: Benedict's, heat, colour change, blue, red.

1. _____
2. _____
3. _____
4. _____

_____

h

What is the function of phloem tissue?

_____

_____

i

The xylem tissue is composed of hollow tubes strengthened by lignin. What is the function of xylem tissue?

_____

_____

_____

j

Describe how a root hair cell is adapted for the efficient uptake of water and mineral ions.

_____

_____

_____

k

Where, in the plant, is meristem tissue located?

_____

l

Transpiration is:
(Tick the correct box.)

The movement of water molecules from a high water concentration to a lower water concentration across a partially permeable membrane. ☐

The evaporation and diffusion of water from the leaves of a plant. ☐

The movement of glucose molecules around the plant. ☐

Name three factors that affect the rate of transpiration.

- _____
- _____
- _____
- _____

m

Describe how to test for starch.

1. _____
2. _____
3. _____

_____

n

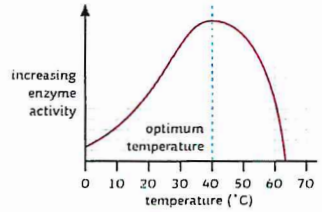
Describe how to test for protein.

1. _____
2. _____
3. _____

_____

o

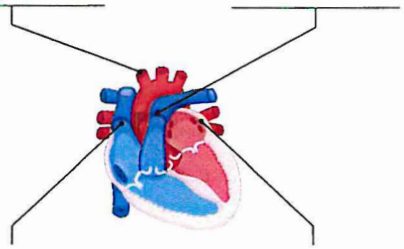
Use the graph below to describe how temperature affects enzyme function. Keywords: optimum, rate of activity, temperature, increase, decrease 50 °C



p

Label the following blood vessels on the diagram of the heart:

aorta, vena cava, pulmonary artery, pulmonary vein.



q

The artery carries blood a _____ from the heart. It has thick layers of m _____ for strength and elastic f _____. The walls are thick with a small l _____.

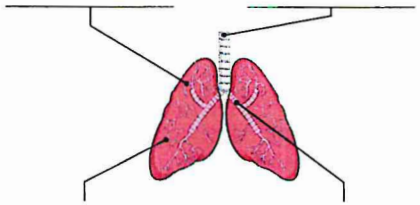
r

Why does the left ventricle have a thicker, more muscular wall than the right ventricle?

s

Label the following parts on the diagram below:

trachea, bronchus, bronchiole, alveolus.



t

In coronary heart disease, layers of fatty material builds up inside the coronary arteries. Explain how this can lead to a heart attack. Keywords: fatty material, oxygen, heart attack, arteries.

u

What are statins? Choose the correct answer.

They reduce the amount of LDL. ☐

They reduce the amount of HDL. ☐

They increase the amount of LDL. ☐

v

Stents can be used to treat coronary heart disease. Give one advantage and one disadvantage of using stents.

advantage: _____

disadvantage: _____

w

How can the valves in the heart become damaged?

What happens when the valves become leaky?

What can they be replaced by?

What could be the problems?

x

A problem with heart transplants is rejection of the donor heart. What is meant by rejection in terms of a heart transplant?

y

Describe two ways that the lungs are adapted for gaseous exchange.

- _____
- _____
- _____
- _____

z

Match up the four components of the blood and their functions

red blood cells	help to clot the blood
white blood cells	transport oxygen
platelets	defend against pathogens
plasma	liquid part of blood

a

Explain how an infection from a microorganism could lead to the development of other, non-communicable diseases.

b

What is the difference between a benign and a malignant tumour?

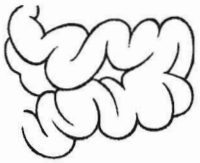
a

Place the following structures in order from smallest to largest:

cell | organ | nucleus | tissue | organism

1. nucleus
2. cell
3. tissue
4. organ
5. organism

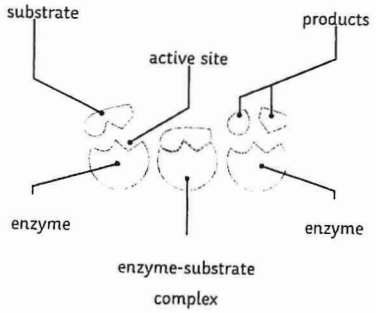
b



The small intestine is the part of the body where food is absorbed into the bloodstream.

c

The diagram below shows the lock and key model of enzyme function. Label the diagram using the following words:
enzyme, active site, substrate, products, enzyme-substrate complex.



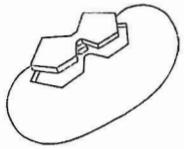
d

Define what an enzyme is.

A biological catalyst.

e

Enzymes are described as being specific to a substrate. What does this mean? Use the diagram to help your explanation.



The active site of the enzyme has a unique shape. Only a substrate with a complimentary shape can fit and bind to form an enzyme-substrate complex.

f

Bile is made in the liver and stored in the gall bladder.

Bile neutralises stomach acid to lower the pH so protease enzymes can work.

It also emulsifies fats to give them a larger surface area for lipase to work on. This speeds up digestion.

g

Describe how to carry out the test for reducing sugars.
Keywords: Benedict's, heat, colour change, blue, red.

1. Place the test sample into a test tube (about 2ml).
2. Add an equal amount of Benedict's reagent.
3. Heat in a water bath for 5 minutes.
4. The colour will change from blue to either green/yellow/red, depending on the amount of reducing sugar present.

h

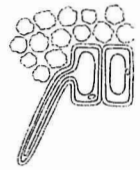
What is the function of phloem tissue?
To transport food substances (dissolved sugars) around the plant. This process is called translocation.

i

The xylem tissue is composed of hollow tubes strengthened by lignin. What is the function of xylem tissue?
To transport water and dissolved minerals from the roots to the stem and the leaves. This is called the transpiration stream.

j

Describe how a root hair cell is adapted for the efficient uptake of water and mineral ions.



They have a large surface area for the rapid absorption of water and mineral ions from the soil.

k

Where, in the plant, is meristem tissue located?
Growing tips of roots and shoots.

l

Transpiration is:
(Tick the correct box.)

The movement of water molecules from a high water concentration to a lower water concentration across a partially permeable membrane.	☐
The evaporation and diffusion of water from the leaves of a plant.	☑
The movement of glucose molecules around the plant.	☐

Name three factors that affect the rate of transpiration.
Any three from the following:

- temperature;
- light intensity;
- air flow;
- humidity.

m

Describe how to test for starch.

1. Place the test sample into a test tube.
2. Add a few drops of iodine solution and mix.
3. The colour will change from orange to blue/black if starch is present.

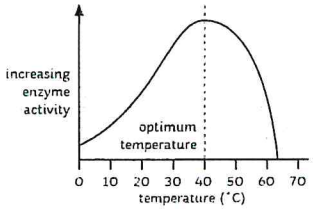
n

Describe how to test for protein.

1. Place the test sample into a test tube (about 2ml).
2. Add an equal amount of Biuret reagent and mix.
3. The colour will change from blue to purple if protein is present.

o

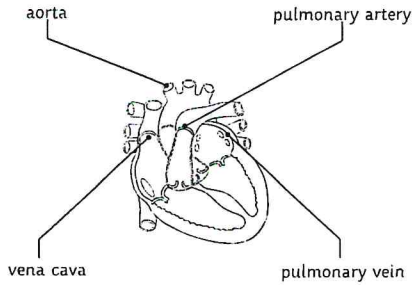
Use the graph below to describe how temperature affects enzyme function. Keywords: optimum, rate of activity, temperature, increase, decrease 50 °C



Initially, as temperature increases, the rate of enzyme activity also increases up to 40°C. This is the optimum temperature. After 40°C, as the temperature increases, the rate of enzyme activity decreases.

p

Label the following blood vessels on the diagram of the heart:
aorta, vena cava, pulmonary artery, pulmonary vein.



q

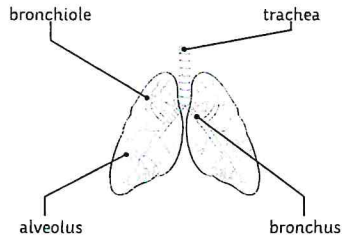
The artery carries blood away from the heart. It has thick layers of muscle for strength and elastic fibres. The walls are thick with a small lumen.

r

Why does the left ventricle have a thicker, more muscular wall than the right ventricle?
The left ventricle has to pump blood at high pressure so that it can reach all body cells. Whereas the right ventricle only has to pump blood to the lungs.

s

Label the following parts on the diagram below: trachea, bronchus, bronchiole, alveolus.



t

In coronary heart disease, layers of fatty material builds up inside the coronary arteries. Explain how this can lead to a heart attack. Keywords: fatty material, oxygen, heart attack, arteries.
The layers of fatty material block the coronary arteries and restrict blood flow to heart muscle cells. This results in a lack of oxygen and the heart muscle cells stop respiring. This can lead to a heart attack.

u

What are statins? Choose the correct answer.

They reduce the amount of LDL. ☑

They reduce the amount of HDL. ☐

They increase the amount of LDL. ☐

v

Stents can be used to treat coronary heart disease. Give one advantage and one disadvantage of using stents.

advantage: Patients recover quickly and they are effective for a long time.

disadvantage: There is a risk of the patient developing a blood clot near the stent, which can lead to a heart attack.

w

How can the valves in the heart become damaged?
Heart attack, infection, old age.

What happens when the valves become leaky?
Blood flows in two directions.

What can they be replaced by?
Biological or mechanical valves.

What could be the problems?
A blood clot.

x

A problem with heart transplants is rejection of the donor heart. What is meant by rejection in terms of a heart transplant?
When the body's immune system (white blood cells) attacks and destroys the donor heart muscle cells.

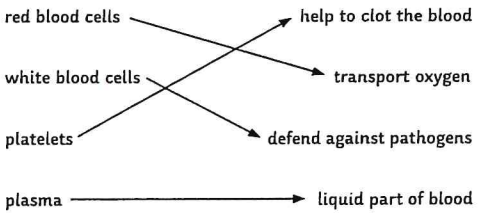
y

Describe two ways that the lungs are adapted for gaseous exchange.
Any three from the following:

- large surface area;
- moist lining;
- thin walls;
- good blood supply.

z

Match up the four components of the blood and their functions



a

Explain how an infection from a microorganism could lead to the development of other, non-communicable diseases.
Infection from some viruses can lead to the development of cancer (e.g. HPV infection and cervical cancer). Also, infection with pathogens can sometimes trigger allergic reactions and worsen asthma, for example.

b

What is the difference between a benign and a malignant tumour?
A benign tumour remains in one place and doesn't invade other tissues in the body – not usually dangerous.
A malignant tumour spreads to other parts of the body when cells break off and travel in the bloodstream to form secondary tumours.

a

Circle the correct word in the definitions below and then write the following diseases under the correct group: HIV, cancer, diabetes, measles, rose black spot, heart disease.

communicable disease: Caused by pathogens and can/cannot be passed from one person to another.

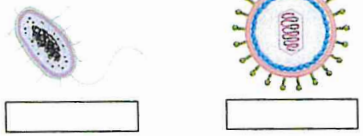
_____

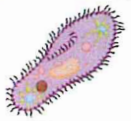
non-communicable disease: Can/cannot be passed on from one person to another.

_____

b

Label the pathogens below that cause infectious diseases.





c

Name three ways that pathogens are spread and match these pathogens with the correct method: cholera, flu, HIV.

1. By a_____: _____.
2. By d_____: _____.
3. By w_____: _____.

d

How do pathogens cause disease?
Fill in the gaps.

_____ reproduce rapidly by _____. They may produce _____ that damage tissues and make us feel ill.

_____ take over the cells of your body. They live and rapidly _____ inside, this causes cell damage.

Keywords: toxins, viruses, reproducing, bacteria, binary fission

e

Simple hygiene measures are one of the most effective ways of preventing the spread of pathogens. List 5 ways we can be more hygienic below:

- _____ after using the toilet, before cooking or eating, and after contact with animals or sick people.
- Using _____ on surfaces.
- Keeping _____ away from food that is eaten uncooked.
- _____ or _____ into a tissue.
- Keeping _____, and people using it, clean to prevent the spread of _____ diseases.

Keywords: disinfectants, coughing, plant, raw meat, washing hands, agricultural machinery, sneezing

f

List three other methods for preventing the spread of pathogens.

1. Keep infected individuals in _____.
2. Destroy the _____ that carry pathogens.
3. _____.

g

Salmonella
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

h

Measles
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

i

Tobacco Mosaic Virus
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

j

Gonorrhoea
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

k

HIV
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

l

Malaria
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

m

Rose Black Spot
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?

_____

_____

How is it spread?

_____

_____

What can we do about it?

_____

_____

a

Explain how your skin prevents microorganisms getting into your body.

It acts as a _____ to prevent _____ reaching the tissues beneath. _____ quickly form scabs to seal any cuts.

It produces _____ secretions to kill pathogens.

It is covered with _____ that act as an extra barrier to entry.

Keywords: antimicrobial, microorganisms, platelets, barrier, pathogens

b

Explain how the respiratory system is adapted to reduce the entry of microorganisms.

The lining of the _____ produces _____ and is full of _____ to trap particles in the air that may contain _____.

The lining of the _____ and _____ produce _____ which is moved to the back of the throat by the _____ projections of _____ cells.

Keywords: cilia, mucus, nose, pathogens, bronchi, epithelial, trachea, hairs

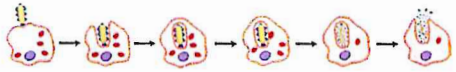
c

Explain how the digestive system is adapted to reduce the entry of microorganisms.

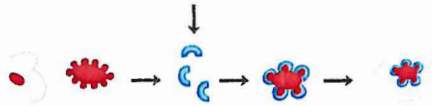
The _____ produces _____ acid that destroys pathogens.

d

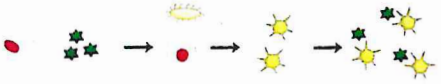
Describe each role of a white blood cell and explain how it protects you against disease.



Some white blood cells _____ pathogens, digesting and destroying them.



Some white blood cells produce _____ which are chemicals that target _____ pathogens and destroy them. An _____ only works for one type of _____.



Some white blood cells produce _____ that counteract the _____ released by pathogens.

Keywords: toxins, specific, antibody, antibodies, ingest, antitoxins, pathogen

e

Tick the correct boxes.

	Treats Symptoms	Kills Bacteria	Kills Viruses
painkillers			
antibiotics			

f

Write the correct keyword next to its definition: vaccine, herd immunity, antigen, antibody

Dead or inactivated form of a disease causing microorganism. _____

Unique protein on the surface of cells. _____

Produced by white blood cells to recognise specific antigens. _____

When vaccination of a significant proportion of the population provides protection for individuals who are not immune. _____

g

Describe how vaccinations prevent illness.

1. Introduce small quantities of _____ virus.
2. This stimulates white blood cells to produce _____.
3. If the live _____ enters the body, the white blood cells _____ it and respond _____ so you don't get ill.

h

Fill in the missing words:

The use of _____ has greatly reduced the deaths from infectious _____ diseases. However, the evolution of strains that are _____ to antibiotics is a concern.

_____ are specific which means they only work against _____.

Keywords: bacterial, certain bacteria, resistant, antibiotics

i

State where the following drugs were discovered.

The heart drug digitalis: _____
The painkiller aspirin: _____
The antibiotic penicillin: _____

Who discovered penicillin? _____

Why is it difficult to discover new medicines?

_____

_____

j

Where do most new drugs now come from?

_____ by chemists in a lab, but they might still start from a chemical extracted from a _____.

What has to happen before a drug can be used?

1. Test whether the drug is _____ against the disease.
2. Check that the drug is not _____.
3. Work out what _____ to use.

k

Describe each process of drug testing.

preclinical testing:

_____

_____

_____

clinical trials:

_____

_____

_____

double-blind trials:

_____

_____

_____

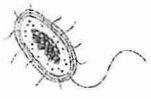
a

Circle the correct word in the definitions below and then write the following diseases under the correct group: HIV, cancer, diabetes, measles, rose black spot, heart disease.

communicable disease: Caused by pathogens and **can**/cannot be passed from one person to another.
HIV, measles, rose black spot
non-communicable disease: Can/**cannot** be passed on from one person to another.
cancer, diabetes, heart disease

b

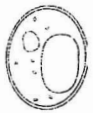
Label the pathogens below that cause infectious diseases.



bacteria

virus

protist



fungi

c

Name three ways that pathogens are spread and match these pathogens with the correct method: cholera, flu, HIV.

1. By air: **flu.**
2. By direct contact: **HIV.**
3. By water: **cholera.**

d

How do pathogens cause disease?
Fill in the gaps.
Bacteria reproduce rapidly by **binary fission**. They may produce **toxins** that damage tissues and make us feel ill.
Viruses take over the cells of your body. They live and rapidly **reproduce** inside, this causes cell damage.
Keywords: toxins, viruses, reproducing, bacteria, binary fission

e

Simple hygiene measures are one of the most effective ways of preventing the spread of pathogens. List 5 ways we can be more hygienic below:

- **Washing hands** after using the toilet, before cooking or eating, and after contact with animals or sick people.
- Using **disinfectants** on surfaces.
- Keeping **raw meat** away from food that is eaten uncooked.
- **Coughing** or **sneezing** into a tissue.
- Keeping **agricultural machinery**, and people using it, clean to prevent the spread of **plant** diseases.

Keywords: disinfectants, coughing, plant, raw meat, washing hands, agricultural machinery, sneezing

f

List three other methods for preventing the spread of pathogens.

1. Keep infected individuals in **isolation.**
2. Destroy the **vectors** that carry pathogens.
3. **vaccination.**

g

Salmonella
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?
Fever, abdominal cramps, vomiting and diarrhoea.

How is it spread?
Eating undercooked food or food contaminated from contact with raw meat, e.g. raw chicken.

What can we do about it?
Poultry are vaccinated to control the spread.

h

Measles
Circle the correct pathogen.
bacteria, **virus**, protist, fungus

What are the symptoms?
A fever and red rash on the skin. Can be fatal if there are complications.

How is it spread?
By air - the inhalation of droplets from coughs and sneezes.

What can we do about it?
There is no treatment, so young children are vaccinated against it.

i

Tobacco Mosaic Virus
Circle the correct pathogen.
bacteria, **virus**, protist, fungus

What are the symptoms?
Mosaic discolouration of the leaves which reduces photosynthesis and affects the growth of the plant.

How is it spread?
Direct contact between diseased plant material and healthy plants. Insects can also act as vectors.

What can we do about it?
TMV resistant strains. Good hygiene and pest control.

j

Gonorrhoea
Circle the correct pathogen.
bacteria, virus, protist, fungus

What are the symptoms?
Thick yellow or green discharge from the vagina or penis and pain on urinating.

How is it spread?
Sexual contact.

What can we do about it?
Treat with antibiotics. Use a barrier method of contraception.

k

HIV
Circle the correct pathogen.
bacteria, **virus**, protist, fungus

What are the symptoms?
Initially causes a flu-like illness. Damages the immune system so that it can't deal with other infections or cancers.

How is it spread?
Sexual contact or exchange of bodily fluids, such as blood.

What can we do about it?
Antiretroviral drugs help to stop the virus attacking the immune system. There is no cure or vaccine.

l

Malaria
Circle the correct pathogen.
bacteria, virus, **protist**, fungus

What are the symptoms?
Recurrent fever. Can be fatal.

How is it spread?
Mosquitos act as a vector, passing the protist to the human bloodstream when they feed on the blood.

What can we do about it?
Preventing the vectors (mosquitos) from breeding. Using mosquito nets and repellents to avoid being bitten. Taking antimalarial drugs.

m

Rose Black Spot
Circle the correct pathogen.
bacteria, virus, protist, **fungus**

What are the symptoms?
Purple or black spots develop on the leaves.Leaves turn yellow and fall of prematurely which reduces photosynthesis, affecting the growth of the plant.

How is it spread?
Spores are carried by water or wind.

What can we do about it?
Use fungicides to treat the plant.
Remove and destroy affected leaves.

a

Explain how your skin prevents microorganisms getting into your body.

It acts as a **barrier** to prevent **pathogens** reaching the tissues beneath. **Platelets** quickly form scabs to seal any cuts.

It produces **antimicrobial** secretions to kill pathogens.

It is covered with **microorganisms** that act as an extra barrier to entry.

Keywords: antimicrobial, microorganisms, platelets, barrier, pathogens

b

Explain how the respiratory system is adapted to reduce the entry of microorganisms.

The lining of the **nose** produces **mucus** and is full of **hairs** to trap particles in the air that may contain **pathogens**.

The lining of the **trachea** and **bronchi** produce **mucus** which is moved to the back of the throat by the **cilia** projections of **epithelial** cells.

Keywords: cilia, mucus, nose, pathogens, bronchi, epithelial, trachea, hairs

c

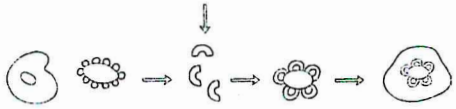
Explain how the digestive system is adapted to reduce the entry of microorganisms.

The **stomach** produces **hydrochloric** acid that destroys pathogens.

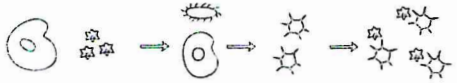
d

Describe each role of a white blood cell and explain how it protects you against disease.

Some white blood cells **ingest** pathogens, digesting and destroying them.



Some white blood cells produce **antibodies** which are chemicals that target **specific** pathogens and destroy them. An **antibody** only works for one type of **pathogen**.



Some white blood cells produce **antitoxins** that counteract the **toxins** released by pathogens.

Keywords: toxins, specific, antibody, antibodies, ingest, antitoxins, pathogen

e

Tick the correct boxes.

	Treats Symptoms	Kills Bacteria	Kills Viruses
painkillers	✓		
antibiotics		✓	

f

Write the correct keyword next to its definition: vaccine, herd immunity, antigen, antibody

Dead or inactivated form of a disease causing microorganism. **vaccine**

Unique protein on the surface of cells. **antigen**

Produced by white blood cells to recognise specific antigens. **antibody**

When vaccination of a significant proportion of the population provides protection for individuals who are not immune. **herd immunity**

g

Describe how vaccinations prevent illness.

1. Introduce small quantities of **dead or inactive** virus.
2. This stimulates white blood cells to produce **antibodies**.
3. If the live **pathogen** enters the body, the white blood cells **recognise** it and respond **quickly** so you don't get ill.

h

Fill in the missing words:

The use of **antibiotics** has greatly reduced the deaths from infectious **bacterial** diseases. However, the evolution of strains that are **resistant** to antibiotics is a concern.

Antibiotics are specific which means they only work against **certain bacteria**.

Keywords: bacterial, certain bacteria, resistant, antibiotics

i

State where the following drugs were discovered.

The heart drug digitalis: **foxglove**
The painkiller aspirin: **willow**
The antibiotic penicillin: ***Penicillium* mould**

Who discovered penicillin? **Alexander Fleming**

Why is it difficult to discover new medicines?
You need to find a chemical that kills bacteria without damaging human cells.

j

Where do most new drugs now come from?

Synthesised by chemists in a lab, but they might still start from a chemical extracted from a **plant**.

What has to happen before a drug can be used?

1. Test whether the drug is **effective** against the disease.
2. Check that the drug is not **toxic**.
3. Work out what **dose** to use.

k

Describe each process of drug testing.

preclinical testing:

This happens in a laboratory using cells, tissues and animals.

clinical trials:

To use healthy volunteers and patients. Starting off with very low doses to check for side effects. If it is safe it is tested on patients.

double-blind trials:

These tell you how effective a medicine is. Neither the patient or the doctor know whether the patient has been given a placebo or the real drug.

a

Complete the word equation for photosynthesis.

_____

_____ + _____ → _____ + glucose

b

Join the chemical formula to the correct chemical name.

CO_2	oxygen
H_2O	glucose
O_2	carbon dioxide
$C_6H_{12}O_6$	water

c

Choose the correct answer:

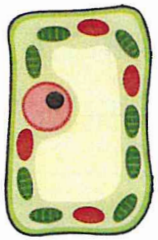
Photosynthesis is an exothermic/endothermic reaction.

Fill in the blanks:

In photosynthesis, _____ is transferred from the e_____ to the c_____ by l_____.

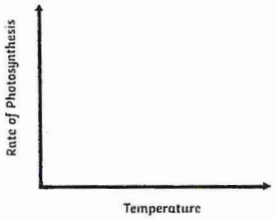
d

On the diagram of a plant cell below, label the part of the cell where photosynthesis happens.



e

Draw a line on the graph to show how temperature affects the rate of photosynthesis.

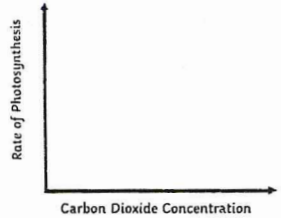


Explain how temperature affects the rate of photosynthesis.

As the temperature increases, the rate of photosynthesis _____. When the temperature gets too high, the enzymes that control photosynthesis _____ and the rate of photosynthesis _____.

f

Draw a line on the graph to show how carbon dioxide affects the rate of photosynthesis.



Describe how carbon dioxide affects the rate of photosynthesis.

Increasing the concentration of carbon dioxide will _____ the rate of the photosynthesis until _____.

g

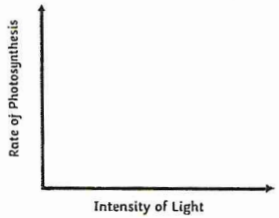
How does the rate of photosynthesis affect the biomass of a plant?

_____

_____

h

Draw a line on the graph to show how light intensity affects the rate of photosynthesis.



Describe how light intensity affects the rate of photosynthesis.

Increasing light intensity _____ the rate of photosynthesis until _____.

i

Use the keywords to complete the five ways that glucose produced in photosynthesis could be used.

1. For _____.
2. Converted into insoluble _____ for _____.
3. Used to produce ____ or ____ for _____.
4. Used to produce _____, which strengthens the _____.
5. Used to produce _____ for _____. To produce _____ plants also need _____ ions that are absorbed from the soil.

Keywords: cellulose, nitrate, starch, amino acids, respiration, storage, proteins, cell wall, oil, fat, protein synthesis

j

Explain how the amount of chlorophyll in a leaf affects the rate of photosynthesis.

The less chlorophyll in a leaf, _____

_____

Give two reasons there may be less chlorophyll in the leaf.

1. _____

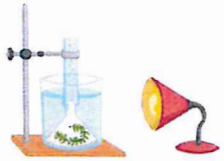
_____

2. _____

_____

k

The illustration shows a method for investigating the effect of light intensity on photosynthesis.



How could you measure the rate of photosynthesis using this equipment?

_____

_____

Circle the independent variable in this experiment from the list below.

- Number of bubbles;
- volume of gas;
- distance of the lamp from the pondweed;
- volume of water;
- temperature of the water.

We often add a heat shield to the apparatus shown, what is the purpose of this?

To absorb any _____ given off by the _____ so that we can control the _____ of the pondweed.

Why do we need to control some variables in an experiment?

To make sure it is a _____ and so that we can collect _____ results.

a

Respiration is an exothermic/endothermic reaction that takes place in the m_____ of cells.

The more active a cell is, the more mitochondria it needs. Name two cell types that have lots of mitochondria.

_____

_____

Respiration transfers e_____ into a form we can use for living processes.

Join the type of respiration to the correct definition to show how respiration can take place.

aerobic	without oxygen
anaerobic	using oxygen

b

Complete the word equation for aerobic respiration.

glucose + _____ → _____ + _____

Complete the formula equation for aerobic respiration.

$C_6H_{12}O_6$ + _____ → _____ + _____

c

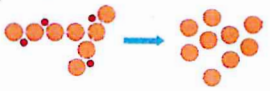
Give three reasons that organisms need energy.

1. For c_____ r_____ that build bigger m_____.
2. For m_____.
3. For keeping w_____.

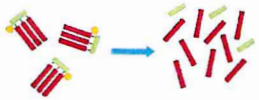
d

The illustrations show the macromolecules in the foods that we eat. Put the keywords into the correct boxes to identify the molecules they are broken down into.

Keywords: fatty acids, sugars/glucose, amino acids, glycerol



carbohydrates	→



lipids	→

proteins	→

The small dots on each of the larger molecules represent the catalysts that help to break down the food. What are these called?

_____

Why is respiration important in this process?
The e_____ need the e_____ that is r_____ from respiration to carry out their job.

e

Complete the word equation for anaerobic respiration in plant and yeast cells.

_____ → _____ + _____

What is anaerobic respiration in yeast called?

_____

Why does this process have economic importance?

_____

f

What is metabolism?
The sum of all the _____ in a cell, or the body.

Metabolism includes the synthesis of new molecules. Complete the sentences to identify some of the molecules that are made in plant and/or animal cells.

1. Glucose is converted to s_____, g_____ and c_____.
2. Glycerol and _____ molecules of fatty acid are used to form _____.
3. Glucose and n_____ ions are used to form _____, which are used to form _____.

What happens to excess proteins in the body?
They are broken down to form u_____ for excretion.

g

Explain what happens to your heart rate when you exercise.

- Your heart rate _____ so that _____ oxygenated blood is carried to your muscles.
- Therefore, more _____ and _____ reach the cells.
- The rate of _____ can increase to transfer more _____ for muscle _____.
- _____ is removed from the muscles at a faster rate.

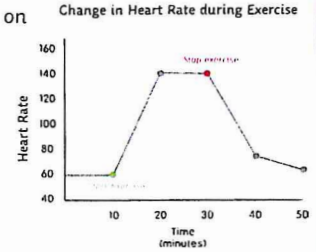
h

Explain what happens to your breathing rate when you exercise.

- Your breathing rate and breath volume _____.
- The rate at which _____ is brought into your body is _____.
- The rate at which _____ is removed is _____.
- This means more _____ is available to be transported to cells for _____.

i

The graph shows the effect of exercise on heart rate.



How long did the person exercise for?

_____

How much did their heart rate increase during exercise?

_____

j

When does anaerobic respiration happen?

_____

_____

Complete the word equation for anaerobic respiration in muscles.

_____ → _____

Why is anaerobic respiration not as efficient as aerobic respiration?

_____

_____

k

Explain what happens to your muscles during long periods of vigorous activity.

There is a build up of _____ which contributes to muscle f_____.

Muscles stop _____ effectively.

An o_____ d_____ is created.

a

Complete the word equation for photosynthesis.

sunlight

carbon dioxide + **water** → **oxygen** + glucose

b

Join the chemical formula to the correct chemical name.

CO_2	oxygen
H_2O	glucose
O_2	carbon dioxide
$C_6H_{12}O_6$	water

c

Choose the correct answer:

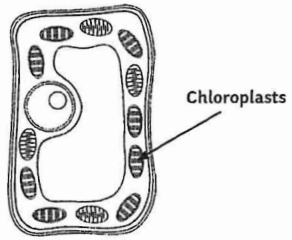
Photosynthesis is an exothermic/**endothermic** reaction.

Fill in the blanks:

In photosynthesis, **energy** is transferred from the **environment** to the **chloroplasts** by **light**.

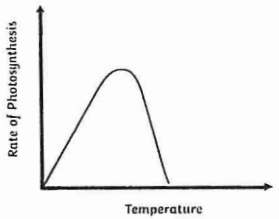
d

On the diagram of a plant cell below, label the part of the cell where photosynthesis happens.



e

Draw a line on the graph to show how temperature affects the rate of photosynthesis.

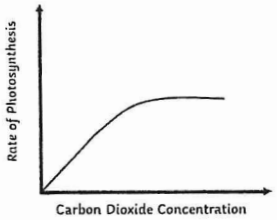


Explain how temperature affects the rate of photosynthesis.

As the temperature increases, the rate of photosynthesis **increases**. When the temperature gets too high, the enzymes that control photosynthesis **denature** and the rate of photosynthesis **decreases**.

f

Draw a line on the graph to show how carbon dioxide affects the rate of photosynthesis.



Describe how carbon dioxide affects the rate of photosynthesis.
Increasing the concentration of carbon dioxide will **increase** the rate of the photosynthesis until **another factor limits the rate**.

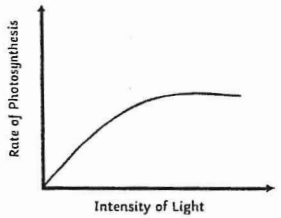
g

How does the rate of photosynthesis affect the biomass of a plant?

The more photosynthesis, the more biomass the plant makes, so the faster it grows.

h

Draw a line on the graph to show how light intensity affects the rate of photosynthesis.



Describe how light intensity affects the rate of photosynthesis.

Increasing light intensity **increases** the rate of photosynthesis until **another factor limits the rate.**

i

Use the keywords to complete the five ways that glucose produced in photosynthesis could be used.

1. For **respiration**.
2. Converted into insoluble **starch** for **storage.**
3. Used to produce **fat** or **oil** for **storage.**
4. Used to produce **cellulose**, which strengthens the **cell wall.**
5. Used to produce **amino acids** for **protein synthesis**. To produce **proteins** plants also need **nitrate** ions that are absorbed from the soil.

Keywords: cellulose, nitrate, starch, amino acids, respiration, storage, proteins, cell wall, oil, fat, protein synthesis

j

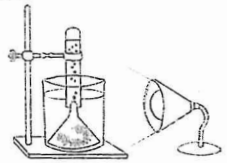
Explain how the amount of chlorophyll in a leaf affects the rate of photosynthesis.
The less chlorophyll in a leaf, **the less photosynthesis.**

Give two reasons there may be less chlorophyll in the leaf.

1. **If the plant has diseases, like tobacco mosaic virus or rose black spot.**
2. **If the plant does not have enough minerals, like magnesium.**

k

The illustration shows a method for investigating the effect of light intensity on photosynthesis.



How could you measure the rate of photosynthesis using this equipment?
Count the number of bubbles released in a given time (e.g. per minute).

Circle the independent variable in this experiment from the list below.

- Number of bubbles;
- volume of gas;
- **distance of the lamp from the pondweed;**
- volume of water;
- temperature of the water.

We often add a heat shield to the apparatus shown, what is the purpose of this?

To absorb any **heat** given off by the **lamp** so that we can control the **temperature** of the pondweed.

Why do we need to control some variables in an experiment?

To make sure it is a **fair test** and so that we can collect **valid** results.

a

Respiration is an **exothermic**/endothermic reaction that takes place in the **mitochondria** of cells.

The more active a cell is, the more mitochondria it needs. Name two cell types that have lots of mitochondria.
muscle cells, sperm cells, ciliated epithelial cells, phloem companion cells

Respiration transfers **energy** into a form we can use for living processes.

Join the type of respiration to the correct definition to show how respiration can take place.

aerobic	using oxygen
anaerobic	without oxygen

b

Complete the word equation for aerobic respiration.

glucose + **oxygen** → **carbon dioxide** + **water**

Complete the formula equation for aerobic respiration.

$C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O$

c

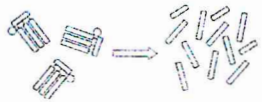
Give three reasons that organisms need energy.

1. For **chemical reactions** that build bigger **molecules**.
2. For **movement**.
3. For keeping **warm**.

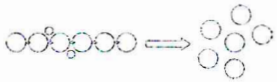
d

The illustrations show the macromolecules in the foods that we eat. Put the keywords into the correct boxes to identify the molecules they are broken down into.
Keywords: fatty acids, sugars/glucose, amino acids, glycerol

carbohydrates → **sugars/glucose**



lipids → **fatty acids and glycerol**



proteins → **amino acids**

The small dots on each of the larger molecules represent the catalysts that help to break down the food. What are these called?
enzymes

Why is respiration important in this process?
The **enzymes** need the **energy** that is **released** from respiration to carry out their job.

e

Complete the word equation for anaerobic respiration in plant and yeast cells.
glucose → ethanol + carbon dioxide

What is anaerobic respiration in yeast called?
fermentation

Why does this process have economic importance?
It is used to make alcohol and bread.

f

What is metabolism?
The sum of all the **reactions** in a cell, or the body.

Metabolism includes the synthesis of new molecules. Complete the sentences to identify some of the molecules that are made in plant and/or animal cells.

1. Glucose is converted to **starch**, **glycogen** and **cellulose**.
2. Glycerol and **three** molecules of fatty acid are used to form **lipids**.
3. Glucose and **nitrate** ions are used to form **amino acids**, which are used to form **proteins.**

What happens to excess proteins in the body?
They are broken down to form **urea** for excretion.

g

Explain what happens to your heart rate when you exercise.

- Your heart rate **increases** so that **more** oxygenated blood is carried to your muscles.
- Therefore, more **oxygen** and **glucose** reach the cells.
- The rate of **respiration** can increase to transfer more **energy** for muscle **contraction**.
- **Carbon dioxide** is removed from the muscles at a faster rate.

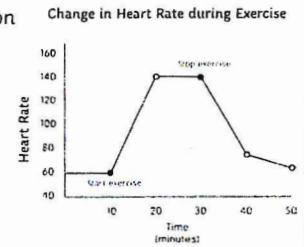
h

Explain what happens to your breathing rate when you exercise.

- Your breathing rate and breath volume **increase.**
- The rate at which **oxygen** is brought into your body is **increased.**
- The rate at which **carbon dioxide** is removed is **increased.**
- This means more **oxygen** is available to be transported to cells for **respiration.**

i

The graph shows the effect of exercise on heart rate.



How long did the person exercise for?
20 minutes

How much did their heart rate increase during exercise?
80 beats per minute

j

When does anaerobic respiration happen?
When your body can't supply oxygen to the muscles fast enough.

Complete the word equation for anaerobic respiration in muscles.

glucose → lactic acid

Why is anaerobic respiration not as efficient as aerobic respiration?
The glucose molecules are not completely broken down, so much less energy is transferred.

k

Explain what happens to your muscles during long periods of vigorous activity.

There is a build up of **lactic acid** which contributes to muscle **fatigue**.

Muscles stop **contracting** effectively.

An **oxygen debt** is created.

PRACTICE PAPER

AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE
COMBINED SCIENCE: TRILOGY

F

Foundation Tier
Biology Paper 1F

Tuesday 16 May 2023 Morning Time allowed: 1 hour 15 minutes

Materials
For this paper you must have:
- a ruler
- a scientific calculator.

Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

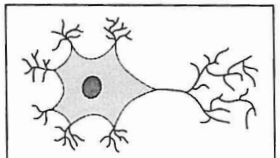
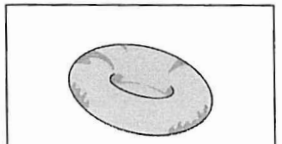
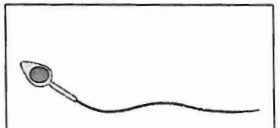
For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
TOTAL	

Information
- The maximum mark for this paper is 70.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

Do not write outside the box

0 1 The human body is made of different types of cell.

0 1 . 1 Draw **one** line from each type of cell to the organ system where the cell is found.
[3 marks]

Type of cell	Organ system
 Brain cell	Circulatory system
 Red blood cell	Nervous system
 Sperm cell	Reproductive system
	Respiratory system

Do not write outside the box

0 1 . 2 Explain **one** way a sperm cell is adapted for its function.

[2 marks]

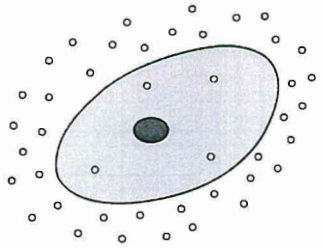
Question 1 continues on the next page

Do not write outside the box

Figure 1 shows a cell.

Oxygen molecules are shown inside and outside the cell.

Figure 1



Key

○ Oxygen molecule

0 1 . 3 Give **one** way you can tell that the cell in **Figure 1** is **not** a plant cell.

[1 mark]

0 1 . 4 Which part of a cell controls the movement of substances into and out of the cell?

[1 mark]

Tick (✓) **one** box.

- Cell membrane ☐
- Cytoplasm ☐
- Nucleus ☐

Do not write outside the box

0 1 . 5 What is the name of the process that moves oxygen molecules into the cell in **Figure 1**?

Give the reason for your answer.

[2 marks]

Tick (✓) **one** box.

Active transport ☐

Diffusion ☐

Osmosis ☐

Reason _____

_____

0 1 . 6 Name **two** substances that move **into** most cells in the body from the blood.

Do **not** refer to oxygen in your answer.

[2 marks]

1 _____

2 _____

11

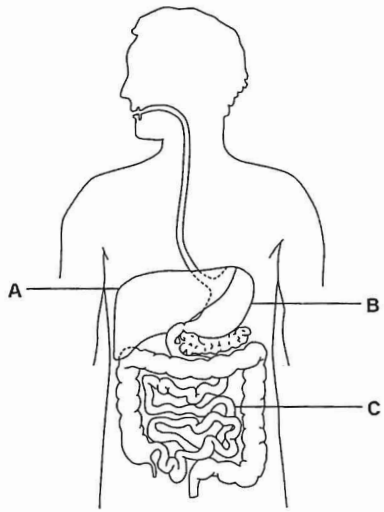
Turn over for the next question

Do not write outside the box

0 2 Enzymes break down food in the digestive system.

Figure 2 shows the human digestive system.

Figure 2



The enzyme amylase digests starch.

0 2 . 1 Which part of the digestive system produces amylase?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☐ C ☐

Do not write outside the box

0 2 . 2 What molecules are produced when starch is digested?

[1 mark]

Tick (✓) **one** box.

- Amino acids ☐
- Fatty acids ☐
- Sugars ☐

0 2 . 3 Where is digested food absorbed into the blood?

[1 mark]

Tick (✓) **one** box.

- Liver ☐
- Pancreas ☐
- Small intestine ☐

Question 2 continues on page 9

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

A student investigated the effect of pH on the digestion of starch by amylase.

This is the method used.

1. Put 1 drop of iodine solution into each well of a spotting tile.
2. Prepare amylase solution at pH 5
3. Mix the amylase solution with starch solution in a test tube.
4. Every 30 seconds remove a drop of the amylase–starch mixture. Add each drop to iodine solution in a different well of the spotting tile.
5. Record the colour of the iodine solution after the amylase–starch mixture has been added.
6. Repeat steps 2 to 5 using amylase solutions at different pH values.

0 2 . 4 What is the independent variable in this investigation?

[1 mark]

Tick (✓) **one** box.

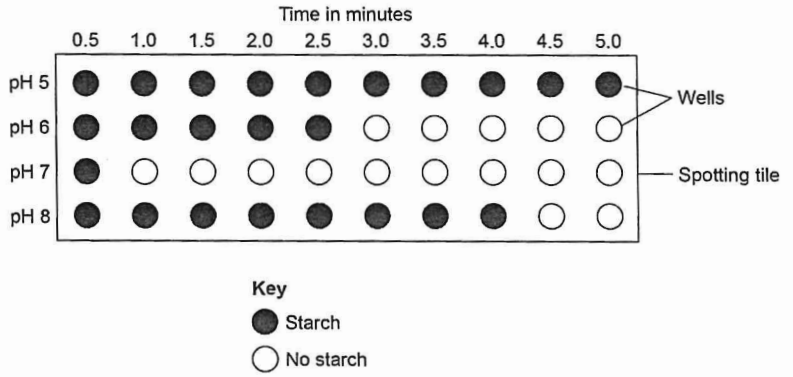
- pH of the amylase solution ☐
- Time when the samples were taken ☐
- Volume of iodine solution ☐

Question 2 continues on the next page

Do not write outside the box

Figure 3 shows the results on the spotting tile.

Figure 3



0 2 . 5 What colours do the symbols in the key represent?

Choose answers from the box.

[2 marks]

black	**green**	**lilac**	**orange**	**white**

● _____

○ _____

Do not write outside the box

0 2 . 6 Look at the results for pH 6 in **Figure 3.**

How many minutes did it take for all the starch to be digested at pH 6?

[1 mark]

_____ minutes

0 2 . 7 What was the optimum pH for the amylase to work?

Use **Figure 3.**

[1 mark]

Tick (✓) **one** box.

pH 5 ☐ pH 6 ☐ pH 7 ☐ pH 8 ☐

8

Turn over for the next question

Do not write outside the box

There are no questions printed on this page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED

Do not write outside the box

0 3 Plants need water for photosynthesis.

0 3 . 1 Where do plants obtain water for photosynthesis from?

[1 mark]

Plants lose water from their leaves through small pores called stomata.

0 3 . 2 What is the evaporation of water from leaves called?

[1 mark]

Tick (✓) **one** box.

- Active transport ☐
- Respiration ☐
- Transpiration ☐

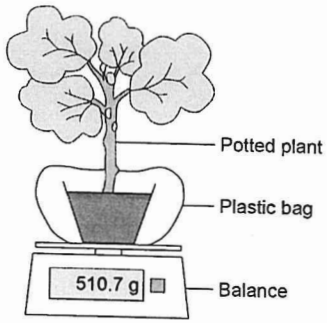
Question 3 continues on the next page

Do not write outside the box

A student investigated the mass of water lost from a plant.

Figure 4 shows the apparatus.

Figure 4



This is the method used.

1. Seal a plastic bag around the pot of a potted plant.
2. Place the plant on a balance in a room at 20 °C.
3. Record the mass.
4. Record the mass every hour for 5 hours.
5. Calculate the total mass of water lost from the plant after each hour.

Do not write outside the box

Table 1 shows the results.

Table 1

Time in hours	Mass in grams	Total mass of water lost in grams
0	510.7	0.0
1	508.9	1.8
2	507.1	3.6
3	505.3	5.4
4	503.5	7.2
5	**X**	9.0

0 3 . 3 Calculate mass **X** in **Table 1**.

[2 marks]

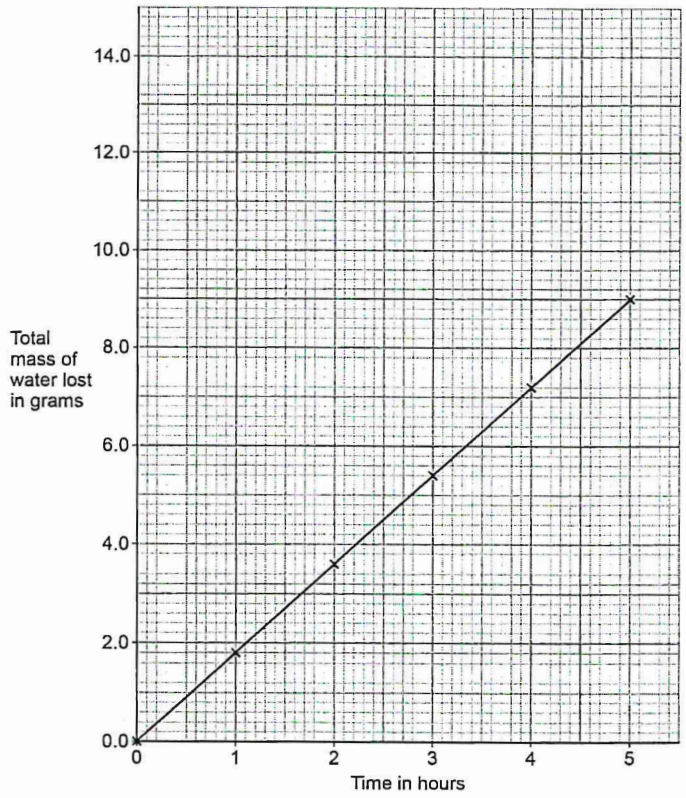
Mass **X** = _____ grams

Question 3 continues on the next page

Do not write outside the box

Figure 5 shows the results.

Figure 5



Do not write outside the box

0 3 . 4 What was the rate of water loss from the plant?

[1 mark]

Tick (✓) **one** box.

0.9 grams/hour ☐

1.8 grams/hour ☐

9.0 grams/hour ☐

0 3 . 5 The investigation was repeated at a **lower** temperature.

Draw **one** line on **Figure 5** to show how the results would be different at a **lower** temperature.

[2 marks]

0 3 . 6 Suggest **one** change to the investigation that would **increase** the rate of water loss from the plant.

Do **not** refer to temperature in your answer.

[1 mark]

_____

_____

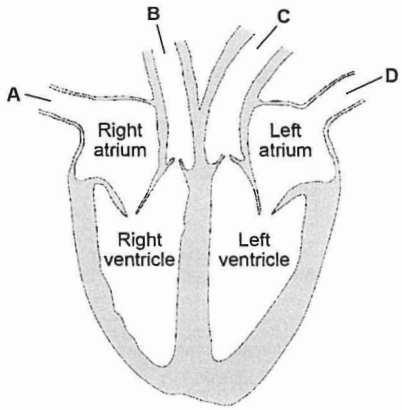
8

Turn over for the next question

Do not write outside the box

0 4 **Figure 6** shows a human heart.

Figure 6



0 4 . 1 The vena cava carries blood into the heart from the body.

Which blood vessel in **Figure 6** is the vena cava?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

Do not write outside the box

0 4 . 2 Which chamber of the heart pumps blood to the body?

[1 mark]

Tick (✓) **one** box.

- Left atrium ☐
- Left ventricle ☐
- Right atrium ☐
- Right ventricle ☐

0 4 . 3 What is the name of the blood vessel that carries blood to the heart muscle?

[1 mark]

Tick (✓) **one** box.

- Aorta ☐
- Coronary artery ☐
- Pulmonary artery ☐

Question 4 continues on the next page

Do not write outside the box

The heart and some blood vessels contain valves.

0 4 . 4 Which type of blood vessel has valves?

[1 mark]

Tick (✓) **one** box.

- Artery ☐
- Capillary ☐
- Vein ☐

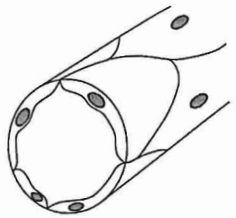
0 4 . 5 What is the function of valves?

[1 mark]

Do not write outside the box

Figure 7 shows a blood capillary.

Figure 7



0 4 . 6 Explain **one** way the capillary is adapted for its function.

[2 marks]

Question 4 continues on the next page

Do not write outside the box

Table 2 shows information about the blood of four people.

Table 2

Person	Concentration of blood component in number/mm^3		
	Red blood cells	White blood cells	Platelets
W	5 000 000	15 000	200 000
X	4 700 000	5 500	20 000
Y	8 000 000	7 200	250 000
Z	4 900 000	6 400	225 000

0 4 . 7 Person **W** has 5 000 000 red blood cells in 1 mm^3 of blood.

What is 5 000 000 written in standard form?

[1 mark]

Tick (✓) **one** box.

- 5 × 1 000 000 ☐
- 5 × 10^6 ☐
- 5 × 10^7 ☐
- 50 × 10^5 ☐

Do not write outside the box

0 4 . 8 Draw **one** line from each description to the person in **Table 2** it describes.

[2 marks]

Description	Person in Table 2
	Person **W**
Person most likely to have an infection	Person **X**
Person whose blood will **not** clot properly	Person **Y**
	Person **Z**

Question 4 continues on the next page

Do not write outside the box

0 4 . 9 The greater the height above sea level, the less oxygen there is in the air.

People who live high above sea level have more red blood cells than people who live at sea level.

Some athletes train in mountains high above sea level.

Explain why having more red blood cells will improve an athlete's performance.

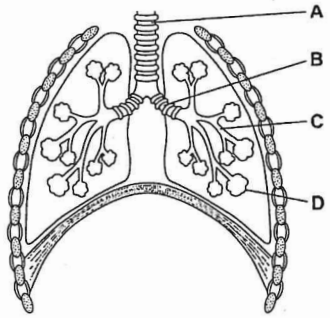
[3 marks]

13

Do not write outside the box

0 5 **Figure 8** shows the human breathing system.

Figure 8



0 5 . 1 Name parts **A** and **B**.

Choose answers from the box.

[2 marks]

alveolus	**bronchus**	**capillary**	**trachea**

A _____

B _____

0 5 . 2 Where does gas exchange happen in the breathing system?

[1 mark]

Tick (✓) **one** box.

A ☐ B ☐ C ☐ D ☐

Do not write outside the box

0 5 . 3 Give **two** ways that the lungs are adapted for efficient gas exchange.

[2 marks]

1 _____

_____

2 _____

_____

Table 3 shows the percentage of gases in air breathed into the lungs and air breathed out of the lungs.

Table 3

Gas	Percentage (%) in air breathed in	Percentage (%) in air breathed out
Oxygen	21	16
Carbon dioxide	0.04	4
Nitrogen	78	78

Do not write outside the box

0 5 . 4 Explain the **differences** in the air breathed into the lungs and the air breathed out of the lungs.

[4 marks]

0 5 . 5 The percentages given in each column of **Table 3** do **not** add up to 100%.

Suggest **one** reason why.

[1 mark]

10

Turn over for the next question

Do not write outside the box

0 6 Communicable and non-communicable diseases are major causes of ill health.

0 6 . 1 Which disease is a **non-communicable** disease?

[1 mark]

Tick (✓) **one** box.

- AIDS ☐
- Cancer ☐
- Gonorrhoea ☐
- Malaria ☐

Obesity is a risk factor for many non-communicable diseases.

0 6 . 2 Give **one** non-communicable disease that obesity is a risk factor for.

Do **not** refer to the diseases given in Question **06.1** in your answer.

[1 mark]

0 6 . 3 National policies are used to help people who are obese to lose weight.

One national policy is to reduce the amount of sugar added to food and drinks.

Suggest **one other** national policy that could help people to lose weight.

[1 mark]

Do not write outside the box

0 6 . 4 Body mass index (BMI) is one measure of obesity.

BMI is calculated using the equation:

$$\text{BMI} = \frac{\text{body mass in kg}}{(\text{height in m})^2}$$

Table 4 shows how BMI is used to describe an adult's BMI category.

Table 4

BMI	BMI category
<18.5	Underweight
18.5 to 24.9	Healthy weight
25.0 to 29.9	Overweight
>29.9	Obese

A person is 1.64 m tall and has a mass of 69 kg.

Determine the **BMI category** for this person.

Use the BMI equation and **Table 4**.

[3 marks]

The person's BMI category is _____

Question 6 continues on the next page

Do not write outside the box

Scientists investigated the effect of smoking and of BMI on the birth mass of babies.

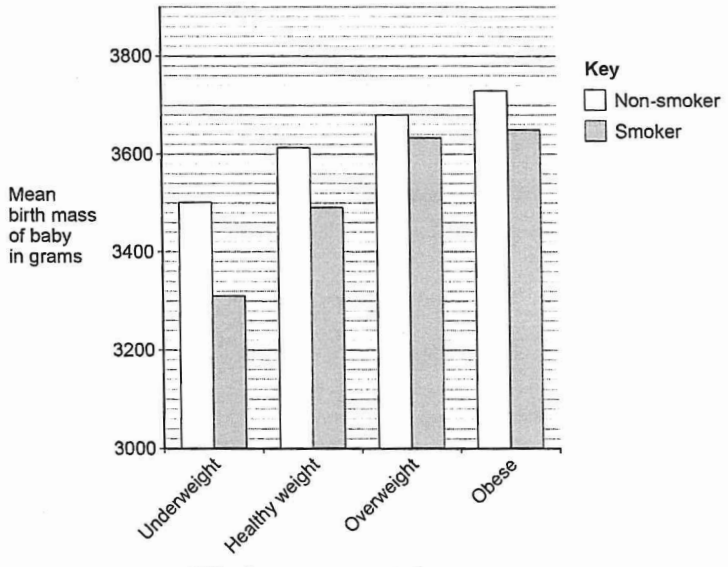
Women's BMI categories were determined before the women became pregnant.

0 6 . 5 Suggest why BMI categories were determined **before** the women became pregnant.

[1 mark]

Figure 9 shows the results.

Figure 9



Do not write outside the box

0 6 . 6 Give **two** conclusions that can be made from **Figure 9**.

[2 marks]

1 _____

_____

2 _____

_____

0 6 . 7 Measles is a communicable disease.

A virus causes measles.

Describe how the measles virus is transferred from person to person.

[2 marks]

_____

_____

_____

_____

Question 6 continues on the next page

Do not write outside the box

Athlete's foot is a communicable disease.

A fungus causes athlete's foot.

The athlete's foot fungus infects the skin on feet.

0 6 . 8 Scientists estimate that 17% of the UK population have athlete's foot.

The estimated UK population is 67 961 900

Calculate how many people are estimated to have athlete's foot.

[2 marks]

_____

_____

_____

Estimated number of people with athlete's foot = _____

0 6 . 9 Athlete's foot fungus grows in moist conditions.

Suggest **one** way a person could reduce their chance of catching athlete's foot.

[1 mark]

_____

_____

14

Turn over for the next question

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ANSWER IN THE SPACES PROVIDED

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0 7 **Figure 10** shows onion cells viewed using a light microscope.

Figure 10

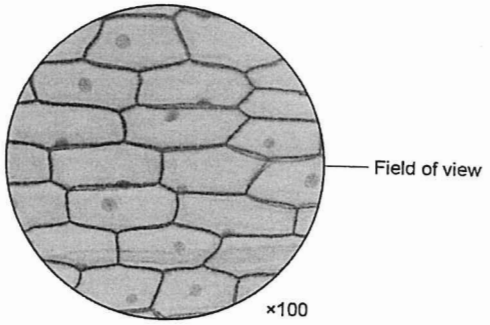
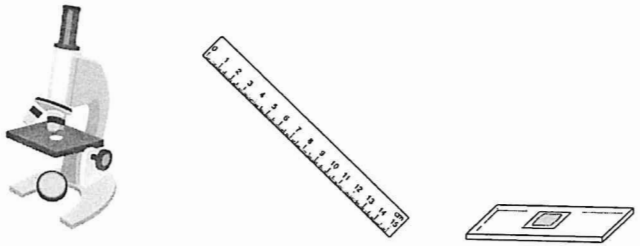


Figure 11 shows the apparatus given to a student.

Figure 11



Microscope

15 cm transparent ruler

Prepared slide of onion cells

Do not write outside the box

Describe how the student could use the apparatus to estimate the **mean** length of onion cells on the slide.

[6 marks]

6

END OF QUESTIONS

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ANSWER IN THE SPACES PROVIDED

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Question number	Additional page, if required. Write the question numbers in the left-hand margin.

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Question number	Additional page, if required. Write the question numbers in the left-hand margin.

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Question number	Additional page, if required. Write the question numbers in the left-hand margin.

Do not write outside the box

There are no questions printed on this page

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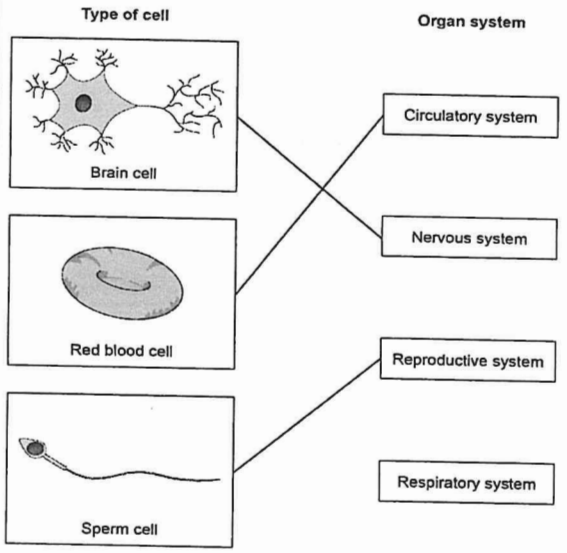
ANSWER IN THE SPACES PROVIDED

Question 1

Question	Answers	Mark	AO / Spec. Ref.
01.1	 do **not** accept more than one line from a box on the left	1 1 1	AO2 4.1.1.3 4.2.1 4.2.2.2 4..2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.2	has a tail	allow has flagellum	1	AO1 4.1.1.2
	(so) it can swim	allow so it can move / travel	1	4.1.1.3
	OR			
	has (many) mitochondria (1)			
	to transfer / release / energy (for sperm to swim) (1)	allow for energy do **not** accept energy is made / produced / created		
	OR			
	has enzyme(s) (1)			
	to penetrate into the egg (1)			
	OR			
	is streamlined (1)			
	to swim faster (1)			
	OR			
	has 23 chromosomes (1)			
	to produce 46 chromosomes in fertilised cell (1)			
		allow a correct adaptation (1) and linked explanation (1)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.3	any **one** from: (cell in **Figure 1**) does **not** have • a (cell) wall • a (large) vacuole • chloroplasts	 ignore chlorophyll	1	AO2 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.4	cell membrane		1	AO1 4.1.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.5	diffusion		1	AO3
	Reason: concentration (of oxygen) is greater outside the cell **or** concentration (of oxygen) is lower inside the cell	allow (oxygen moves) from a high concentration to a low concentration allow there is more (oxygen) outside the cell (than inside the cell) allow there is less (oxygen) inside the cell (than outside the cell) ignore oxygen moves along a concentration gradient	1	AO2 4.1.3.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
01.6	any **two** from: • glucose / sugar • water • amino acids • fatty acids • glycerol • mineral ions	ignore oxygen allow H_2O allow minerals / salts / vitamins / hormones allow named ion / mineral / vitamin / hormone ignore carbon dioxide ignore urea	2	AO2 4.1.3.1 4.2.2.1 4.2.2.3 4.4.2.1 4.4.2.3

Total Question 1	11

Question 2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.1	C		1	AO1 4.2.1 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.2	sugars		1	AO1 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.3	small intestine		1	AO1 4.2.2.1

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.4	pH of the amylase solution		1	AO1 4.2.2.1 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.5	● black ○ orange		1 1	AO2 4.2.2.1 RPA3 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.6	3(.0 minutes)	allow any value in the range 2.51 to 3.0 (minutes) do **not** accept 2.5 (minutes)	1	AO3 4.2.2.1 RPA3 RPA4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
02.7	pH 7		1	AO3 4.2.2.1 RPA3 RPA4

Total Question 2	8

Question 3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.1	soil	allow ground ignore air ignore rain ignore roots	1	AO1 4.4.1.1 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.2	transpiration		1	AO1 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.3	510.7 – 9(.0) **or** 503.5 – 1.8 501.7 (grams)		1 1	AO2 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.4	1.8 grams/hour		1	AO2 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.5	straight line drawn from 0,0 to 5 hours at a less steep gradient below the line on **Figure 5**	ignore any extrapolations	1 1	AO2 AO3 4.2.3.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
03.6	any **one** from: • increase air movement • increase light intensity • decrease humidity	ignore references to temperature ignore references to the bag allow descriptions of how changes could be achieved experimentally eg use a fan	 1	AO3 4.2.3.2

Total Question 3	8

Question 4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.1	A		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.2	left ventricle		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.3	coronary artery		1	AO1 4.2.2.2 4.2.2.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.4	vein		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.5	to stop blood flowing in the wrong direction	allow to stop blood flowing backwards allow to stop backflow (of blood) allow to keep blood flowing in the correct direction	1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.6	walls that are one cell thick	allow thin walls ignore thin unqualified do **not** accept references to cell walls	1	AO1 4.2.2.2
	(so) there is a short diffusion distance	allow (so) substances can move (quickly) between blood and cells / tissues allow (so) diffusion / movement can happen faster allow (so) there is a short distance for substances to move	1	
	OR			
	large surface area (to volume ratio) (1)			
	for exchange of substances (1)	allow (so) more substances can diffuse / move at the same time (1)		
		allow (very) narrow (1) (so) are close to cells (1)		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.7	5×10^6		1	AO2 4.2.2.3

Question	Answers	Mark	AO / Spec. Ref.
04.8	Description → Person in Table 2 Person most likely to have an infection → Person W Person whose blood will **not** clot properly → Person X Person Y Person Z do **not** accept more than one line from a box on the left	1 1	AO3 4.2.2.3

Question	Answers	Extra information	Mark	AO / Spec. Ref.
04.9	more oxygen (can be transported / carried)	allow red blood cells carry oxygen	1	AO2 4.2.2.3 4.4.2.1
	(oxygen) is needed for (aerobic) respiration	allow (so) less anaerobic respiration	1	4.4.2.2
	(so) more energy can be transferred / released	do **not** accept energy is made / produced / created	1	

Total Question 4	13

Question 5

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.1	(A) trachea		1	AO1 4.2.1
	(B) bronchus	must be in this order	1	4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.2	D		1	AO1 4.2.2.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.3	any **two** from: • many alveoli		2	AO1 4.2.2.2 4.1.3.1
	• large surface area			
	• short diffusion distance	allow short distance for gas to travel across		
	• wall of alveolus only one cell thick	allow (wall of) alveolus is thin do **not** accept cell wall		
	• wall of blood capillaries only one cell thick	allow thin (wall of) blood capillary do **not** accept cell wall		
	• good blood supply			
	• well ventilated	ignore moist		

Question	Answers	Mark	AO / Spec. Ref.
05.4	**Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account.	3–4	AO2 4.2.2.2 4.4.2.1
	Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.	1–2	
	No relevant content	0	
	Indicative content • less oxygen in exhaled air (than inhaled air) o (because) the body has used some oxygen o for respiration • more carbon dioxide in exhaled air (than inhaled air) o (because) carbon dioxide is produced in respiration o carbon dioxide can cause poisoning (in high concentration) o (so) needs to be removed from the body • no difference in the percentage of nitrogen in inhaled and exhaled air o (because) nitrogen is not used by the body • more water vapour / moisture in air breathed out o (because) water is produced in respiration • exhaled air is warmer (than inhaled air) o (because) energy is transferred during respiration o thermal energy of body warms the exhaled air For **Level 2**, explanation(s) and difference(s) must be given		

Question	Answers	Extra information	Mark	AO / Spec. Ref.
05.5	any **one** from: • there are other gases present • water (vapour) is present • the numbers are rounded	allow named gas eg argon	1	AO3 4.2.2.2 4.4.2.1

Total Question 5	10

Question 6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.1	cancer		1	AO1 4.2.2.7 4.2.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.2	any **one** from: • (coronary) heart disease / CHD / cardiovascular disease • diabetes	ignore cancer allow atherosclerosis ignore heart attack allow high blood pressure allow stroke / asthma / depression / gallstones / (osteo)arthritis allow sleep apnoea	1	AO1 4.2.2.4 4.2.2.5 4.2.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.3	any **one** from: • taxes on high energy / fat / sugar foods • education (about diet and health) • (government) advertising • restrict media advertising of high energy / fat / sugar foods • information on food labels • help / advice / groups for obese people via the NHS • calorie information on restaurant / takeaway menus • regulation of supermarket offers on high sugar / fat / energy foods • regulation of type of foods for sale near checkouts • exercise campaigns	allow increase the price on high energy / fat / sugar foods	1	AO3 4.2.2.5 4.2.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.4	BMI = $\frac{69}{1.64^2}$	allow BMI = $\frac{69}{1.64 \times 1.64}$ allow BMI = $\frac{69}{2.6896}$	1	AO2
	BMI = 25.6(5437....)	allow 26 or 25.7	1	AO2
	(the person's BMI category is) overweight	must be consistent with their calculated BMI value	1	AO3 4.2.2.5 4.2.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.5	any **one** from: • women will gain mass / weight (during pregnancy) • (developing) baby will increase mass / weight of woman	allow BMI (of woman) will increase (during pregnancy)	1	AO3 4.2.2.5 4.2.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.6	any **two** from: • smokers had babies with lower birth mass • women / smokers / non-smokers with higher BMI had heavier babies • smoking had the greatest effect on birth mass in underweight women • smoking had the least effect on birth mass in overweight women • smoking had less effect on birth mass in overweight and obese women (than in underweight and healthy weight women)	statements must be comparative allow converse statements allow weight for mass allow obese women have the heaviest / heavier babies allow underweight women have the lightest / lighter babies allow there is only a 365 g difference between the smallest and largest babies	2	AO3 4.2.2.5 4.2.2.6

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.7	coughs / sneezes (spread virus in droplets) droplets / virus are inhaled	assume 'it' refers to the virus allow breathing out (spreads virus in droplets) allow droplets / virus are breathed in ignore contact with infected person unqualified allow touch a contaminated surface **and** then touch your mouth / nose / eyes for **1** mark if no other marks awarded allow kissing for **1** mark only	1 1	AO1 4.3.1.1 4.3.1.2

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.8	$\frac{17}{100} \times 67\,961\,900$ = 11 553 523	allow 0.17 x 67 961 900 allow 11 553 500	1 1	AO2 4.3.1.4

Question	Answers	Extra information	Mark	AO / Spec. Ref.
06.9	any **one** from: • dry feet thoroughly (after washing) • do not share socks / tights / shoes / towels • use a fungicide • do not walk around barefoot in public / contaminated areas	allow use foot powder ignore keep feet dry ignore wash feet regularly allow named fungicide allow wear silver(-impregnated) socks allow wear flip flops in public / contaminated areas ignore avoid moist conditions	1	AO2 4.3.1.1 4.3.1.4
Total Question 6			**14**	

Question 7

Question	Answers	Mark	AO / Spec. Ref.
07	**Level 3:** The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.	5–6	AO2
	Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically sequenced.	3–4	AO1
	Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.	1–2	AO1
	No relevant content	0	

	Indicative content Method 1 • place ruler on (microscope) stage • focus on (scale on) ruler • measure diameter / width of field of view • in millimetres • replace ruler with slide • focus on cells • use same magnification • estimate / count number of cells that fit (lengthwise) across field of view • (to calculate mean length of onion cells): divide diameter / width of field of view by (estimated) number of cells **or** divide diameter / width of field of view by 3 cells Method 2 • focus on cells • note magnification • take a photograph of the image • calculate a mean: o measure length of several cells (3 or more) cells on the photograph o add all image lengths together and divide total by number of cells (to calculate mean cell image length) OR o measure the length of one cell o calculate the real size o repeat for other cells (3 or more) o calculate the mean real size • (mean) size of real cell = (mean cell) image size / magnification General points • focus under low power first • using focusing knob • then focus at ×100 magnification • reference to how total magnification is calculated • equation: (mean) size of real cell = (mean cell) image size / magnification For **Level 2** attempt at a method to measure cells plus an indication of how to calculate mean length For **Level 3** suitable method and calculation of mean length.		4.1.1.2 4.1.1.5 RPA1

Total Question 7	**6**